OMRON

Smart Sensors

Laser Displacement Sensors CMOS Type

ZX2 Series

User's Manual

Cat. No. Z310-E1-03

CONTENTS

Introduction

Meanings of Signal Words. 8
Meanings of Alert Symbols 8
Laser Safety 9
Precautions for Safe Use. 11
Precautions for Correct Use 12
How to Use This Manual 14

PREPARATION FOR MEASUREMENT

Part Names and Functions 18
Basic Configuration 18
Amplifier Unit 19
Sensor Head 22
Calculating Unit 22
Installation. 23
Installing Sensor Heads. 23
Installing the Amplifier Unit 24
Connecting Calculating Units 25
Connecting the Sensor Head to the Amplifier Unit 27
Wiring Diagram 28
Wiring Input/Output Cables 28
I/O Circuit Diagrams 31

FLOW OF OPERATION

FLOW OF OPERATION. 34

BASIC SETUP

BASIC SETUP 38
Display of RUN Mode 38
Simplest Setting. 38

MAIN APPLICATIONS & SETTING METHODS

Height. 40
Steps and Warpage 45

Double Sheet Detection 50
Thickness 55
Positioning 64
Eccentricity and Surface Deflection 70

DETAILED SETTINGS

Smart Tuning 78
Connecting Two or More Amplifier Units 82
Mutual Interference Prevention 84
Setting the Hysteresis 87
Setting the Hold Function 89
Bank Setting 95
Zero Reset 97
Scaling 101
Analog Output 105
Output for Non-measurement 107
Timer 110
Setting the Differential Function 112
External Input for Bank, Timing Input, Reset Input 114
Setting the Detection Surface Selection 116
Key Lock Function 118
Initializing Settings Data 119

TROUBLESHOOTING

Troubleshooting 124
Error Messages 126
Q&A 129

SPECIFICATIONS

Specifications and Dimensions 132
Amplifier Units 132
Sensor Heads 134
Sensor Head Extension Cables 134
Calculating Unit 136
Timing Charts 137
Engineering Data (Typical) 140
Angle Characteristic 140
Linearity Characteristic for Different Materials 141
Beam Size 142

INDEX 143

Revision History 147

SETTING TRANSITION CHARTS 148

Introduction

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

Thank you for purchasing the ZX2 Series Smart Sensor. This manual provides information regarding functions, performance and operating methods that are required for using the sensor.

When using the ZX2 Smart Sensor, make sure to observe the following:

- The ZX2 Smart Sensor must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.

READ AND UNDERSTAND THIS DOCUMENT

Please read and understand this document before using the products. Please consult your OMRON representative if you have any questions or comments.

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

SUITABILITY FOR USE

THE PRODUCTS CONTAINED IN THIS DOCUMENT ARE NOT SAFETY RATED. THEY ARE NOT DESIGNED OR RATED FOR ENSURING SAFETY OF PERSONS, AND SHOULD NOT BE RELIED UPON AS A SAFETY COMPONENT OR PROTECTIVE DEVICE FOR SUCH PURPOSES. Please refer to separate catalogs for OMRON's safety rated products.

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:
Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.
NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PERFORMANCE DATA

Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the product may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

ERRORS AND OMISSIONS

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

COPYRIGHT AND COPY PERMISSION

This document shall not be copied for sales or promotions without permission.

This document is protected by copyright and is intended solely for use in conjunction with the product. Please notify us before copying or reproducing this document in any manner, for any other purpose. If copying or transmitting this document to another, please copy or transmit it in its entirety.

Meanings of Signal Words

The following signal words are used in this manual.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

Meanings of Alert Symbols

The following alert symbols are used in this manual.

	Indicates the possibility of laser radiation.
	Indicates prohibition when there is a risk of minor injury from electrical shock or other source if the product is disassembled.

Laser Safety

■ ZX2-LD□□□ Sensor Head

⚠ WARNING

Never look into the laser beam.
Doing so continuously will result in visual impairment.

Do not disassemble the product.
Doing so may cause the laser beam to leak, resulting in the danger of visual impairment.

The ZX2-LD□□□ Sensor Head is a Class 2 Laser Product according to EN 60825-1 (IEC 60825-1) and Class II Laser Product according to FDA (21 CFR1040.10) (see note). The ZX2 Series is meant to be built into final system equipment. Pay special attention to the following precautions for the safe use of the product:

Note: Europe: Class 1 and Class 2 of EN 60825-1: 1994 +A11:1996 +A2:2001
= IEC 60825-1:1993 +A1:1997 +A2:2001

U.S.A.: Class I and Class II of FDA (21 CFR1040.10)

(1) ZX2-LD□□□ emits visual laser beam. Do not stare directly into the laser.
Make sure that the laser beam path is terminated. If specular objects are present in the laser beam path, make sure that they are prevented from reflecting the laser beam.
When used without an enclosure, make sure the laser path from eye level is avoided.

(2) To avoid exposure to hazardous laser radiation, do not displace nor remove the protective housing during operation, maintenance, and any other servicing.

(3) As for countries other than those of Europe and the U.S.A., observe the regulations and standards specified by each country.

(4) Label Indications
The EN and FDA labels are supplied with the product.
Replace the current labels with them according to the instructions given in the manuals.

Precautions for Safe Use

Please observe the following precautions for safe use of the products.

■ Installation Environment

- Do not use the product in environments where it can be exposed to inflammable/ explosive gas.
- Do not install the product close to high-voltage devices and power devices in order to secure the safety of operation and maintenance.

■ Power Supply and Wiring

- The supply voltage must be within the rated range (DC12 to 24 V±10%).
- Reverse connection of power supply is not allowed. Connection to AC power supply is also not allowed.
- Open-collector outputs should not be short-circuited.
- High-voltage lines and power lines must be wired separately from this product. Wiring them together or placing in the same duct may cause induction, resulting in malfunction or damage.
- Always turn off the power supply before connecting or disconnecting cables and connectors.

■ Others

- Do not attempt to dismantle, repair, or modify the product.
- Dispose of this product as industrial waste.

Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunctions, or undesirable effects on product performance.

Installation of the Product

■ Installation Site

Do not install the product in locations subjected to the following conditions:

- Ambient temperature outside the rating
- Rapid temperature fluctuations (causing condensation)
- Relative humidity outside the range of 35 to 85%
- Presence of corrosive or flammable gases
- Presence of dust, salt, or iron particles
- Direct vibration or shock
- Reflective sensor of intense light (such as other laser beams or electric arc-welding machines)
- Direct sunlight or near heaters
- Water, oil, or chemical fumes or spray
- Strong magnetic or electric field

Component Installation and Handling

■ Power Supply and Wiring

- To extend the output cables of amplifier units, shielded cables of the same specifications as the output cables must be used.
- When using a commercially available switching regulator, make sure that the FG terminal is grounded.
- If surge currents are present in the power lines, connect surge absorbers that suit the operating environment.
- When connecting two or more amplifier units by using calculating units, make sure that the linear GND lines of the amplifier units are connected to each other. Supply power to all connected amplifier units at the same time.
- Before turning ON the power after the product is connected, make sure that the power supply voltage is correct, there are no incorrect connections (e.g. load short-circuit) and the load current is appropriate. Incorrect wiring may result in breakdown of the product.
- The cables must be 10 m or shorter in total length, for both sensor head and amplifier units. To extend the cable from the sensor head, an optional extension cable (ZX2-XC□R) must be used. For extension of the cable of amplifier units, shielded cables of the same type must be used.
- When using calculating units, make sure that the linear GND lines of the amplifier units are connected to each other.

■ Warming Up

After turning ON the power supply, allow the product to stand for at least 10 minutes before use. The circuits are still unstable just after the power supply is turned ON, so measured values may fluctuate gradually.

■ Sensing Object

The product cannot accurately measure the following types of objects: Transparent objects, objects with an extremely low reflective sensor ratio, objects smaller than the beam size, objects with a large curvature, excessively inclined objects, etc.

■ Mutual Interference

Inserting a calculating unit between amplifier units can prevent mutual interference between two sensor heads. However, this may not work efficiently if one sensor head is saturated and a laser beam of the other sensor head is input. If you are interested in installing a calculating unit in order to prevent mutual interference, carry out a test using the actual system beforehand.

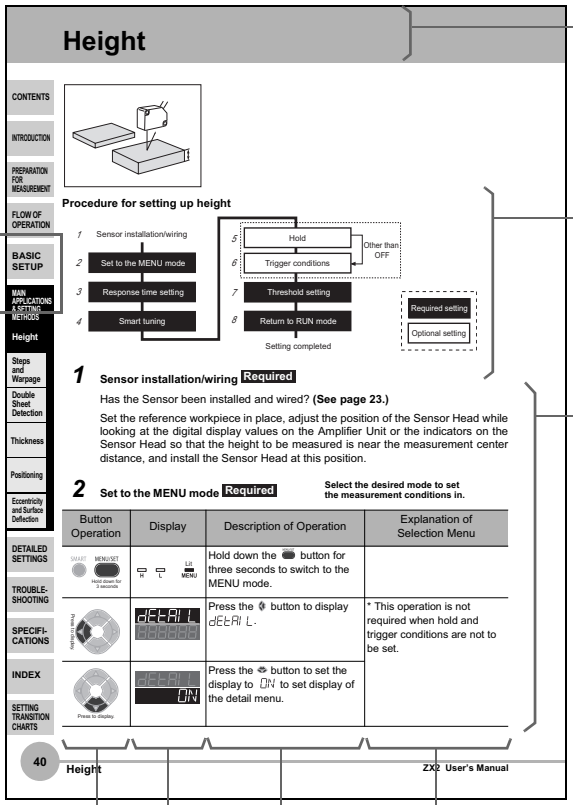
■ Maintenance

- Always turn OFF the power supply before adjusting or connecting/disconnecting the sensor head.
- Do not use thinner, benzene, acetone or kerosene to clean the sensor head and amplifier units. If large dust particles adhere to the front filter of the sensor head, use a blower brush (used to clean camera lenses) to blow them off. Do not blow the dust away with your mouth. To remove smaller dust particles, use a soft cloth (for lenses) with a small amount of alcohol. Take care not to wipe them off with excessive force.
  Scratches on the filter may cause errors.

How to Use This Manual

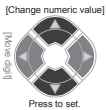
Page Format

This section explains the page format by using the Setting for MAIN APPLICATIONS AND SETTING METHODS chapter as an example.


Height
CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS
Procedure for setting up height
1 Sensor installation/wiring
2 Set to the MENU mode
3 Response time setting
4 Smart tuning
5 Hold
6 Trigger conditions
Other than OFF
7 Threshold setting
8 Return to RUN mode
Setting completed
Required setting
Optional setting
1 Sensor installation/wiring Required
Has the Sensor been installed and wired? (See page 23.)
Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the height to be measured is near the measurement center distance, and install the Sensor Head at this position.
2 Set to the MENU mode Required
Select the desired mode to set the measurement conditions in.
Button Operation
Display
Description of Operation
Explanation of Selection Menu
Hold down the button for three seconds to switch to the MENU mode.
Press the button to display dEtAiL.
* This operation is not required when hold and trigger conditions are not to be set.
Press the button to set the display to ON to set display of the detail menu.
40
Height
ZX2 User's Manual

- **Index label**
  Shows the chapter and header titles with white characters.
- **Header**
  Indicates the measurement contents.
- **Flow**
  Shows the flow of operation.
- **Operation procedure**
  Explains the operation procedure.
- **Explanation of Selection Menu**
  Provides a supplemental explanation of the selection menu.
- **Description of Operation**
  Explains how to perform the operation by using buttons.
- **Display**
  Shows what is displayed as a result of the operation.
- **Button Operation**
  Shows how to use the buttons.

Meanings of Symbols

Symbol	Meaning
Important	Indicates points that are important to achieve the full product performance, such as operational precautions and application procedures.
(For details about xxx, see page xx.)	Indicates pages where related information can be found.
Required (white characters on a black background)	Indicates a required setting in a setup procedure.
Optional (black characters on a white background)	Indicates an optional setting in a setup procedure.
	Indicates which button to press to display the menu shown in the Display column.
Press to select Select the desired value.	Indicates that the user can select the menu that accords with their usage conditions by pressing the relevant button.
 Set any value.	Indicates that the user can specify a value that accords with their usage conditions by pressing the relevant button.

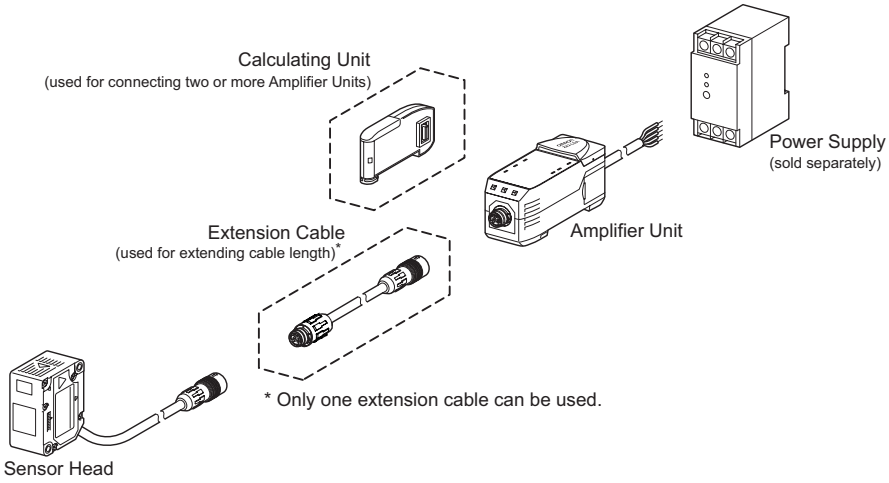
MEMO

PREPARATION FOR MEASUREMENT

Part Names and Functions	**18**
Installation	**23**
Wiring Diagram	**28**

Basic Configuration

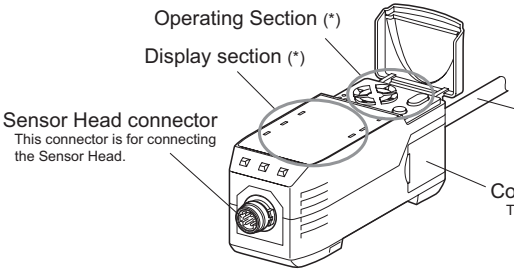
The basic configuration of the ZX2 series Smart Sensors is shown below.



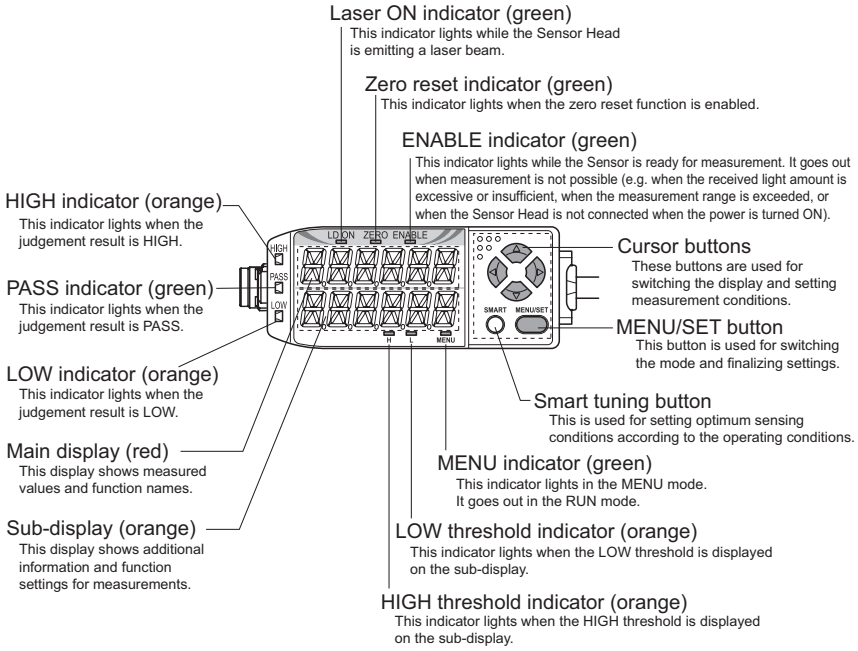
See the following pages for details:

	Part Names and Functions	Specifications and Dimensions
Sensor Heads	p. 22	p. 134
Amplifier Units	p. 19	p. 132
Calculating Unit	p. 22	p. 136
Extension Cables	—	p. 134

Amplifier Unit


Operating Section (*)
Display section (*)
Sensor Head connector
This connector is for connecting the Sensor Head.
Output Cable
This cable is for connecting the power supply and sync sensors or external devices.
Connector (two connectors, one on each side)
This connector is for connecting Calculating Units.

(*) Operating and Display Sections

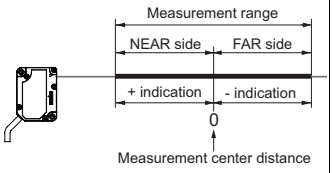

Laser ON indicator (green)
This indicator lights while the Sensor Head is emitting a laser beam.
Zero reset indicator (green)
This indicator lights when the zero reset function is enabled.
ENABLE indicator (green)
This indicator lights while the Sensor is ready for measurement. It goes out when measurement is not possible (e.g. when the received light amount is excessive or insufficient, when the measurement range is exceeded, or when the Sensor Head is not connected when the power is turned ON).
HIGH indicator (orange)
This indicator lights when the judgement result is HIGH.
PASS indicator (green)
This indicator lights when the judgement result is PASS.
LOW indicator (orange)
This indicator lights when the judgement result is LOW.
Main display (red)
This display shows measured values and function names.
Sub-display (orange)
This display shows additional information and function settings for measurements.
Cursor buttons
These buttons are used for switching the display and setting measurement conditions.
MENU/SET button
This button is used for switching the mode and finalizing settings.
Smart tuning button
This is used for setting optimum sensing conditions according to the operating conditions.
MENU indicator (green)
This indicator lights in the MENU mode. It goes out in the RUN mode.
LOW threshold indicator (orange)
This indicator lights when the LOW threshold is displayed on the sub-display.
HIGH threshold indicator (orange)
This indicator lights when the HIGH threshold is displayed on the sub-display.
LD ON
ZERO
ENABLE
HIGH
PASS
LOW
SMART
MENU/SET
H
L
MENU

Digital Displays

The information displayed on the main and sub-displays depends on the currently selected mode. The default mode is the RUN mode.

When the power is turned ON, the model of Amplifier Unit (ZX2-LDA) will be displayed on the main display and the channel number will be displayed on the sub-display. Subsequently, the Sensor Head software version will be displayed on the main display and the Amplifier Unit software version will be displayed on the sub-display.

These details are displayed for approximately five seconds, and then data for the RUN mode will be displayed.

Mode	Main display (upper section, red)	Sub-display (lower section, orange)
RUN	The measured value (the value after the measurement conditions have been reflected) is displayed. For example, when the hold function is set, the held value will be displayed. Default measured values are as follows:  	By pressing the ◆◆ button, the HIGH threshold, LOW threshold, analog output value, resolution (max. value of measured value during one second - min. value), current value (value before execution of zero reset, hold, scaling and 2-sensor operation), and BANK are displayed in this order.
MENU	The function names are displayed in order by pressing the ◆ ◆ buttons.	The setting for the function displayed on the main display is displayed.

(For details on setting transition charts, see page 148.)

Alphabet Display Format

The alphabet appears on the main and sub-displays as shown in the following table.

A	B	C	D	E	F	G	H	I	J	K	L	M

N	O	P	Q	R	S	T	U	V	W	X	Y	Z

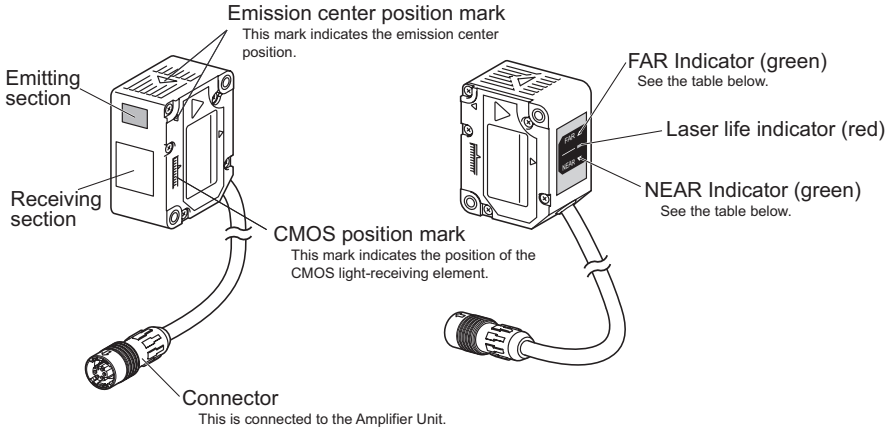
Button Operation

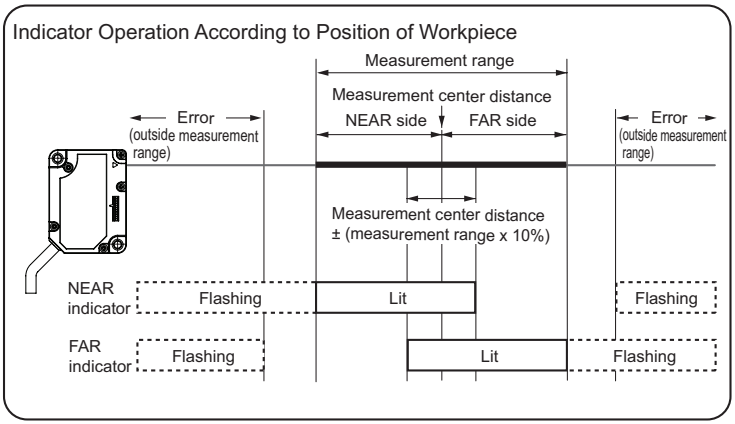
The functions of buttons change according to the currently selected mode.

Button type		Button function	
		RUN mode	MENU mode
Cursor buttons	button button	• Normal press: Changes the sub-display content.* • Both buttons held down for three seconds: Locks button operation.	Function changes depending on the setting. • Switches the function display. • Selects the digit of numerical values. • Stops setting.
	button	• Normal press: Executes timing input.	The function changes depending on the setting. • Changes the selection menu. • Changes numerical values.
	button	• Held down for one second: Executes zero reset. • Both buttons held down for one second: Cancels a zero reset.	
MENU/SET button MENU/SET		• Held down for 3 seconds: Changes the mode to the MENU mode.	• Normal press: Finalizes the set condition or value. • Held down for 3 seconds: Changes to the RUN mode.
Smart tuning button SMART		• Held down for one second, held down for three seconds, held down for five seconds: Executes smart tuning according to the time the button is held down.	• Held down for one second, held down for three seconds, held down for five seconds: Executes smart tuning according to the time the button is held down.

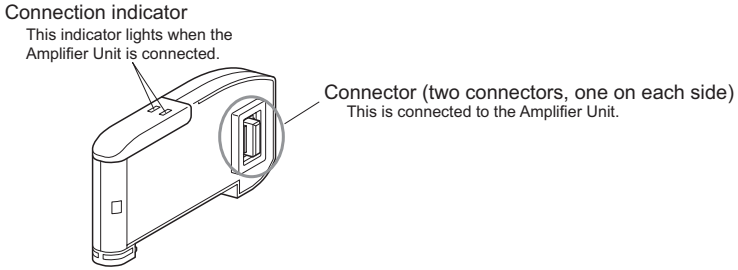
* Do not move the workpiece while a button is being pressed.
The output is not updated while the sub-display is being switched.

Sensor Head


Emission center position mark
This mark indicates the emission center position.
Emitting section
Receiving section
FAR Indicator (green)
See the table below.
Laser life indicator (red)
NEAR Indicator (green)
See the table below.
CMOS position mark
This mark indicates the position of the CMOS light-receiving element.
Connector
This is connected to the Amplifier Unit.



Calculating Unit (used for connecting two or more Amplifier Units)


Connection indicator
This indicator lights when the Amplifier Unit is connected.
Connector (two connectors, one on each side)
This is connected to the Amplifier Unit.

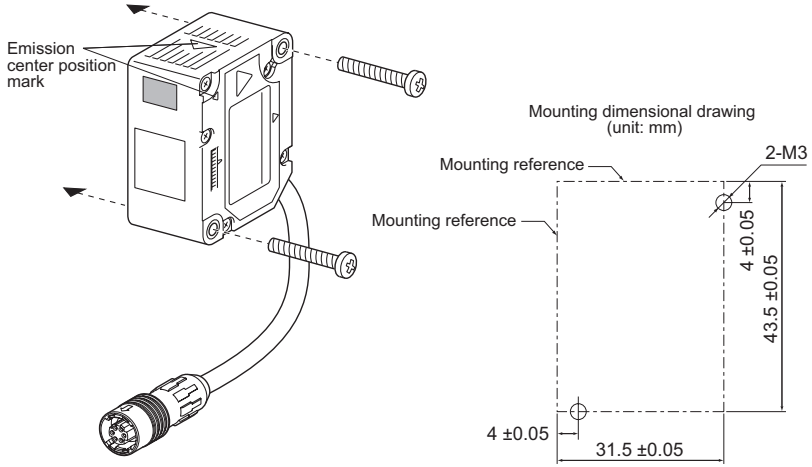
Important

Before connecting/disconnecting Smart Sensor components, make sure that the power to the Amplifier Unit is turned OFF. The Smart Sensor may malfunction if components are connected or removed while the power is ON.

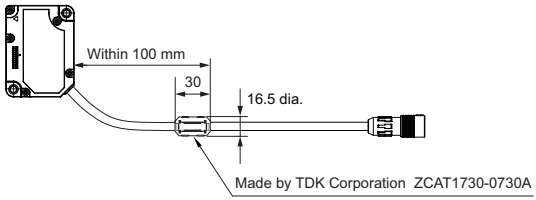
Installing Sensor Heads

Installation Method

- Check the Sensor Head setting position by its emission center mark.
- Fix the sensor head in place with M3 screws. The screws must be tightened with a torque of 0.5 N•m.



- Be sure to attach the ferrite core accessory on the Sensor Head. Attach it within 100 mm of the Sensor Head side.



Important

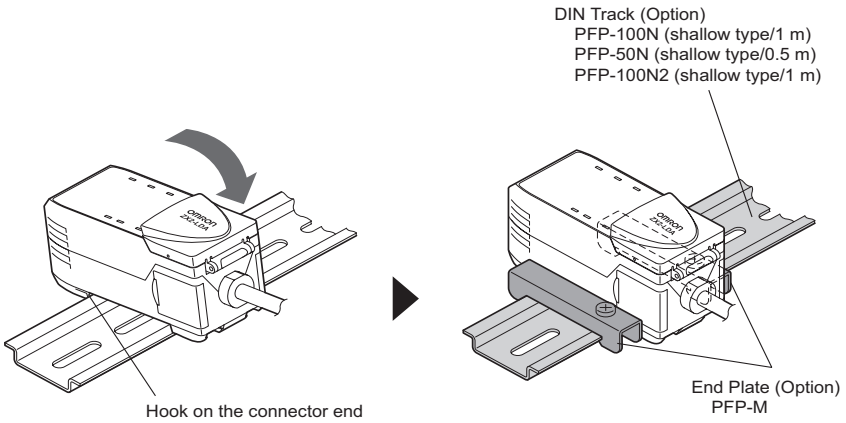
- When mounting a Sensor Head, take care not to touch the emitter and receiver. Finger marks on the emitter and receiver may hinder correct measurements. If you have touched them by mistake, wipe them with a clean, soft cloth.
- Fix the connectors in places that are not subject to vibration or impact.

Installing the Amplifier Unit

Amplifier Units can be easily mounted to 35-mm DIN Track.

Installation Method

Hook the connector end of the Sensor Head on the DIN Track, and press in at the bottom until the Amplifier Unit locks into place. If necessary, fix it in place by the End Plate.

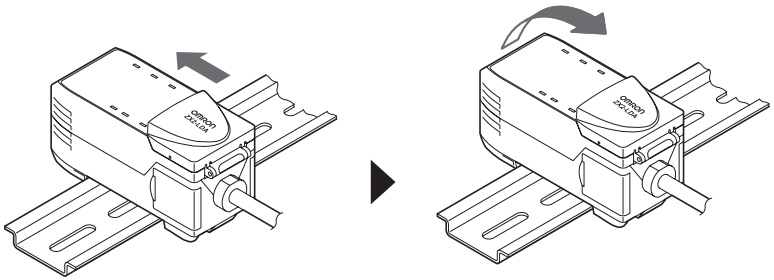


Important

Hook the connector end of the Sensor Head on the DIN Track first. The mounting strength may decrease if the output cable end is hooked on the DIN Track first.

Removal Method

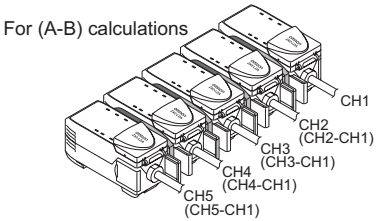
Push the Amplifier Unit and pull out from the connector end of the Sensor Head.



Connecting Calculating Units

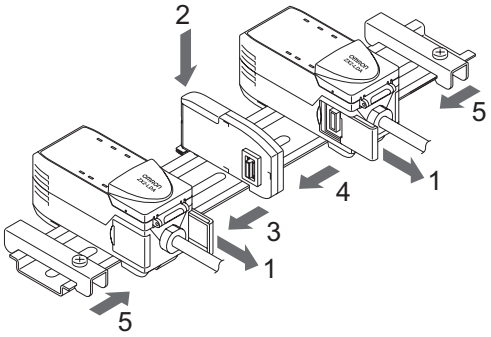
Use a Calculating Unit to connect Amplifier Units when performing calculations between Amplifier Units and to prevent mutual interference between Sensor Heads.

The number of Amplifier Units that can be connected differs depending on the functions to be used.

Function	Number of Connectable Amplifier Units	See:
Calculation	Up to two units (Up to five units can be connected. However, calculations are done between pairs of two.) For (A-B) calculations  	(A-B) calculation: Page 45 Thickness calculation: Page 55
Mutual interference prevention	Up to five units	Page 84

For details on the connection method, see the next page.

Connection Method



1 **Open the connector cover on the Amplifier Unit.**

Open the connector cover by lifting and sliding it.

2 **Mount the Calculating Unit to the DIN Track.**

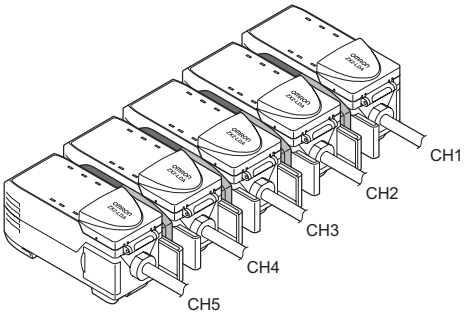
3 **Slide and connect the Calculating Unit to the Amplifier Unit connector.**

4 **Slide and connect the second Amplifier Unit to the Calculating Unit connector.**

5 **Fix in place with the End Plate (sold separately: PFP-M).**

Important

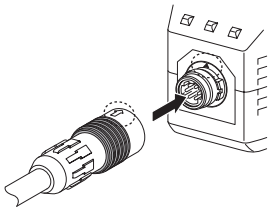
- To disconnect Amplifier Units and Calculating Units, perform the above operations in reverse order.
- The following diagram shows the channel numbers when multiple Amplifier Units are connected.



Connecting the Sensor Head to the Amplifier Unit

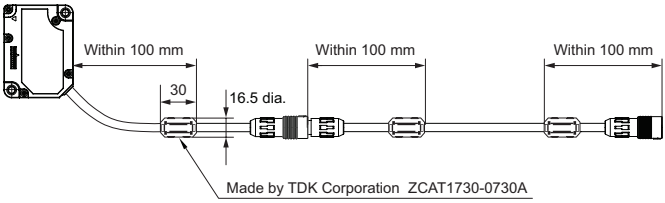
Installation Method

Align the position of the connector ⇨ mark with the ▲ mark on the Amplifier Unit, and insert the connector until it is locked in place.



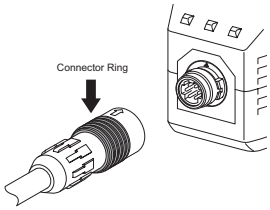
Important

- Extending the Sensor Head cable
  An optional extension cable (ZX2-XC□R) must be used.
  Only one extension cable can be used.
  Be sure to attach the two supplied ferrite cores within 100 mm of each end of the extension cable.



Removal Method

To disconnect the Sensor Head, hold the Sensor Head's connector ring and the Amplifier Unit connector, and then pull them straight out.



Important

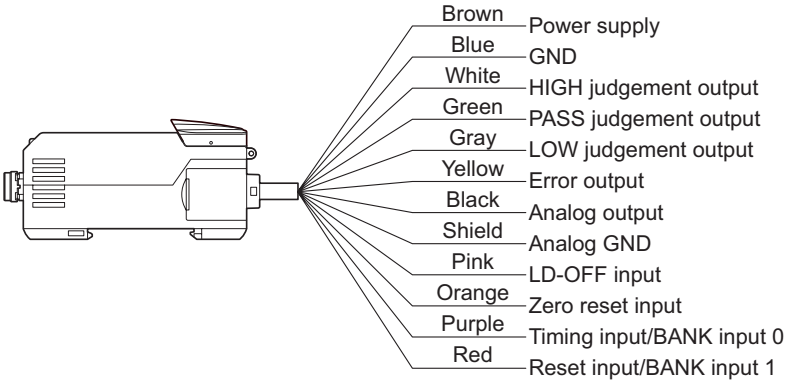
- Do not touch the terminals inside the connector.
- Prevent the connector from being subjected to static electricity.
- When the Sensor Head is replaced with a different type, set all the setting data inside the Amplifier Unit again since it will be cleared. **(default values: → See page 119.)**

Wiring Input/Output Cables

The input/output cable has the following wires.

Important

Wire the cable correctly. Incorrect wiring may damage the Smart Sensor.



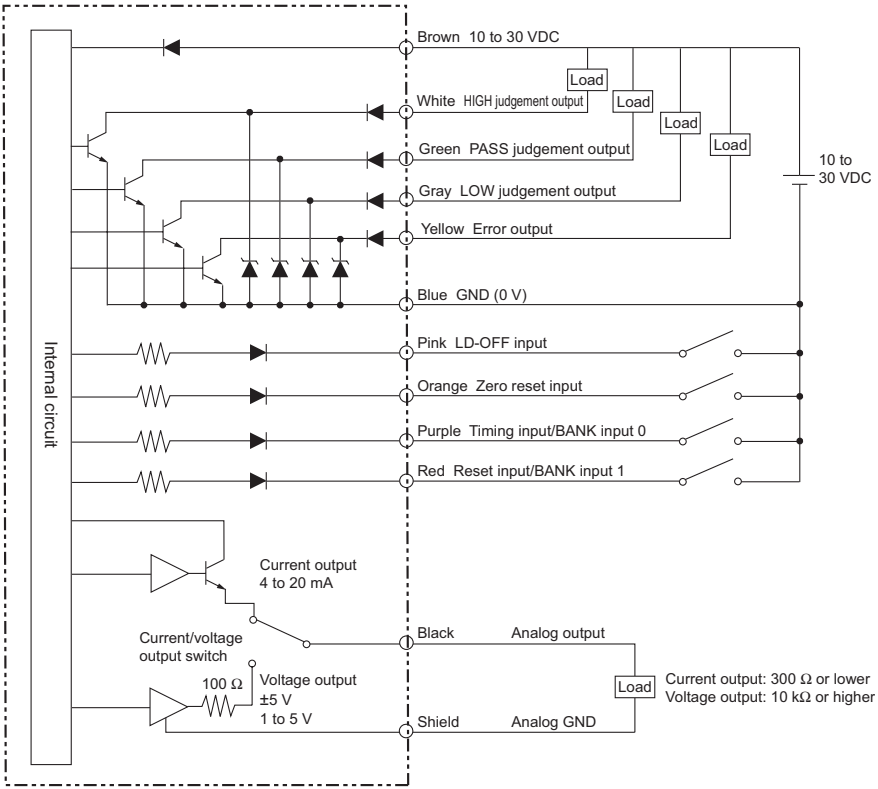
Cable color	Name	Function
Brown	Power supply	Connects the 10 to 30 VDC (including (p-p) 10% ripple) power supply. When using an Amplifier Unit with a PNP output, the power supply terminal is also the common I/O terminal for all I/O except for the analog output.
Blue	GND (0 V)	The GND terminal is the 0 V power supply terminal. When using an Amplifier Unit with an NPN output, the power supply terminal is also the common I/O terminal for all I/O except for the analog output.
White	HIGH judgement output	The HIGH judgement output outputs judgement results (HIGH).
Green	PASS judgment output	The PASS judgement output outputs judgement results (PASS).
Gray	LOW judgment output	The LOW judgement output outputs judgement results (LOW).
Yellow	Error output	This is output when the system detects an error. **(For details on error messages, see page 126.)**

Cable color	Name	Function
Black	Analog output	The analog output outputs a current or voltage in accordance with the measured value. **(For details on setting method, see page 105.)**
Shield	Analog GND (0 V)	The analog GND terminal is the 0 V terminal for the analog output. **Important** • Use the shield for analog output separately from the blue (0V) wire for power supply. • When analog output is not used, be sure to connect this wire to the blue (0 V) wire. • When using Calculating Units, make sure that the analog GND lines of the Amplifier Units are connected to each other.
Pink	LD-OFF input	If this LD-OFF input signal is ON, the laser will stop emission, causing a light intensity error. In this case, the analog output, digital display, judgement output, and judgement output display signals will be output according to the non-measurement settings. The sub-display will show LdOFF.
Orange	Zero reset input	The zero reset input is used to execute and cancel zero reset. **(For details, see page 97.)**
Purple	Timing input/ BANK input 0 (switched by external input setting)	Timing input: Signal input wire for obtaining hold function timing. While this input is being input, the sub-display will show tIMING. BANK input 0: Signal input wire for bank switching. Banks are switched by ON/OFF combinations with BANK input 1. When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for bank switching. The banks of the Amplifier Units of CH2 and later are switched together with CH1. **(For details on switching and inputs, see page 114.)**

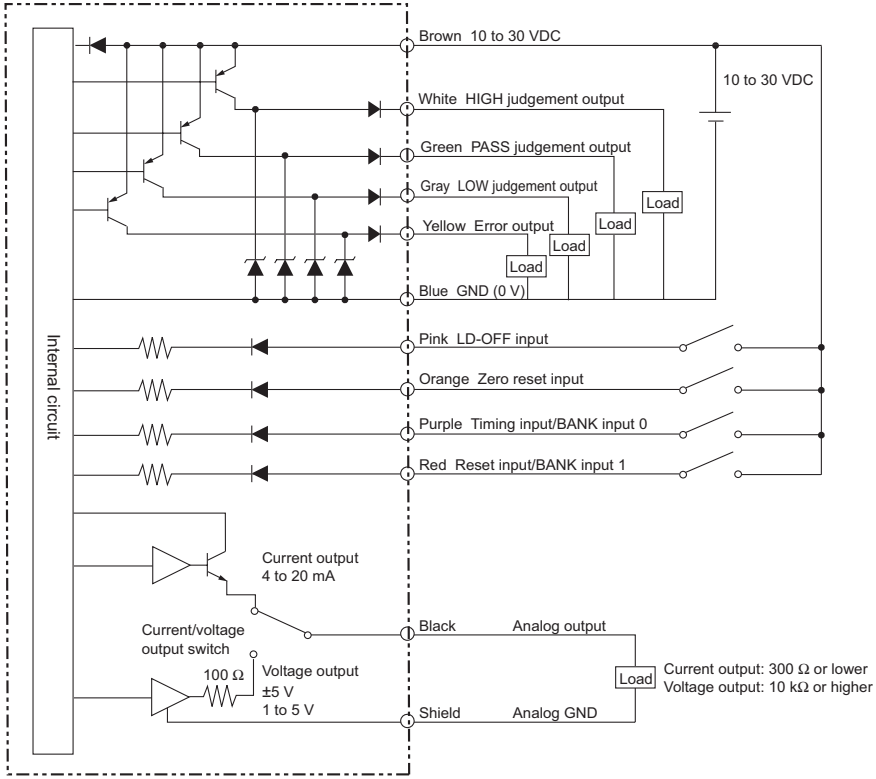
Cable color	Name	Function
Red	Reset input/BANK input 1 (switched by external input setting)	Reset input: The reset input resets all measurement processing and outputs. While reset input is being input, the sub-display will show RESET. The analog and judgement output signals will be output according to the non-measurement settings. If this reset input switches ON while the hold function is used, the state in effect before the hold function was set will be restored. BANK input 1: Signal input wire for bank switching. Banks are switched by ON/OFF combinations with BANK input 0. When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for bank switching. The banks of the Amplifier Units of CH2 and later are switched together with CH1. **(For details on switching and inputs, see page 114.)**

I/O Circuit Diagrams

NPN Amplifier Unit


Internal circuit
Brown 10 to 30 VDC
White HIGH judgement output
Green PASS judgement output
Gray LOW judgement output
Yellow Error output
Blue GND (0 V)
Pink LD-OFF input
Orange Zero reset input
Purple Timing input/BANK input 0
Red Reset input/BANK input 1
Load
10 to 30 VDC
Current output 4 to 20 mA
Current/voltage output switch
100 Ω
Voltage output ±5 V 1 to 5 V
Black Analog output
Shield Analog GND
Current output: 300 Ω or lower
Voltage output: 10 kΩ or higher

PNP Amplifier Unit



FLOW OF OPERATION

FLOW OF OPERATION 34

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

Preparation for Measurement

Installing the Sensor p. 23

↓

Wiring Diagram p. 28

↓

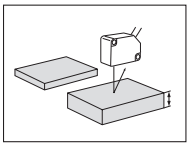
Setup

<Simple Measurement>

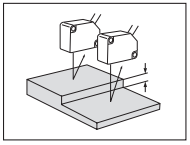
• Basic Setup p. 38

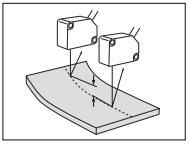
<Setting Up by 6 Measurement Contents>

• Measuring Height and Dimensions p. 40

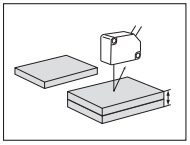


• Measuring Steps and Warpage p. 45

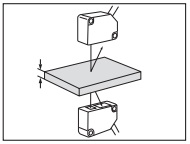




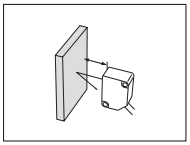
• Detecting Double Sheet Detection p. 50



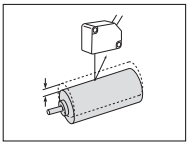
• Measuring Thickness and Insertion p. 55



• Positioning p. 64



• Detecting Eccentricity and Surface Deflection p. 70



Detailed Settings

- Smart Tuning (Optimizing the Sensing Conditions) p. 78
- Connecting Two or More Amplifier Units p. 82
- Mutual Interference Prevention p. 84
- Setting the Hysteresis p. 87
  (Improving Unstable Measurement Near the Judgement Threshold)
- Setting Hold (Holding Measured Values Under Special Conditions) p. 89
- Bank Setting p. 95
- Zero Reset p. 97
- Scaling (Changing Digital Values for Specific Measured Values) p. 101
- Analog Output p. 105
- Output for Non-measurement p. 107
  (Output Setting During Input of the Reset Signal at an Error)
- Timer p. 110
- Setting the Differential Function p. 112
- External Input for Bank, Timing Input, Reset Input p. 114
- Setting the Detection Surface Selection p. 116
  (Decreasing Incorrect Measurement Caused by Multireflection on Workpiece)
- Key Lock Function p. 118
- Initializing Setting Data p. 119

When an Error Occurs

- Troubleshooting p. 124
- Error Messages p. 126
- Q&A p. 129

Engineering Data etc

- Function Transition Charts p. 148
- Specifications and Dimensions p. 132
- Timing Charts p. 137
- Engineering Data (Typical) p. 140

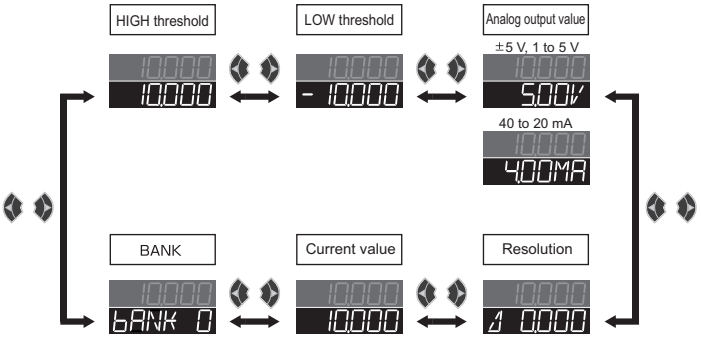
- Index p. 143

MEMO

BASIC SETUP

BASIC SETUP 38

Display of RUN Mode



*1 The main display always shows the measured value.
Default measured values are as follows:
0 reference: Measurement center distance,
+ indication: NEAR side
- indication: FAR side

* The numerals shown in the above diagram are an example only. The actual display may be different.

Simplest Setting

Smart Tuning (Single Smart Tuning)

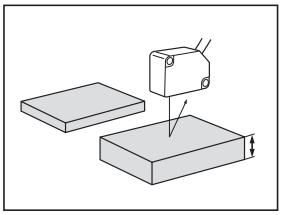
Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the distance between the Sensor Head and the workpiece is the measurement center distance, and install the Sensor Head at this position.	
SMART MENU/SET Hold down for 1 second	Pressing down SMART SINGLE Pressed down TUNING SINGLE Flashing	Press the SMART button for one second. When SMART SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

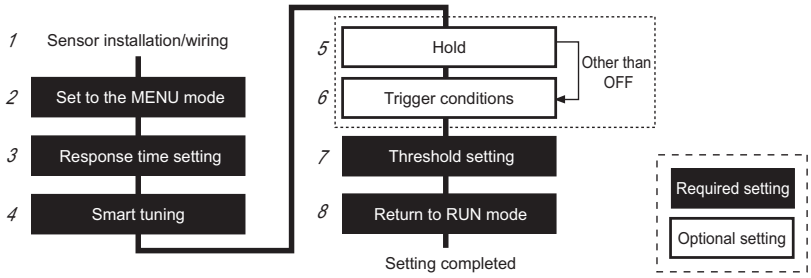
* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

MAIN APPLICATIONS & SETTING METHODS

Height	**40**
Steps and Warpage	**45**
Double Sheet Detection	**50**
Thickness	**55**
Positioning	**64**
Eccentricity and Surface Deflection	**70**



Procedure for setting up height



1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the height to be measured is near the measurement center distance, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This operation is not required when hold and trigger conditions are not to be set.
		Press the button to set the display to ON to set display of the detail menu.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

3 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	SPEEd 888888	Press the button to display SPEEd.	Default value: 500 ms
Press to select	SPEEd 1MS Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
SMART MENU/SET		Press the MENU/SET button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
SMART MENU/SET Hold down for 1 second	Pressing down SMARt SI NGLE Pressed down tUNI NG SI NGLE Flashing	Press the SMART button for one second. When SMARt/ SI NGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILEd" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

5 Hold Optional

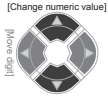
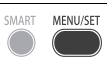
Set this item to hold measured values during the measurement period according to preset hold conditions.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display HOLd.	Default value: OFF
	Select the desired value.	Press the ◆ button to select the hold conditions.	OFF Hold OFF AVE The average measured value during the sampling period is held. P to P The difference between the minimum and maximum values during the sampling period is held. SAMPLE The measured value at the start of the sampling period is held. bOttOM The minimum value during the sampling period is held. PEAK The maximum value during the sampling period is held. **(For details, see page 91.)**
		Press the MENU/SET button to apply the setting. When other than OFF is selected, proceed to "6 Trigger conditions," and when OFF is selected, proceed to "7 Threshold setting."	* The clamp value is output until the first sampling period is finished. **(For details on the clamp value, see page 107.)**

6 Trigger conditions Optional

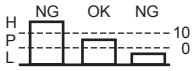
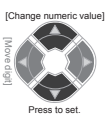
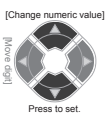
Set how timing of the hold measurement period is to be input.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display trIG.	Default value: TIMING

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the ▲ button to select the trigger conditions.	**EI MI NG** Enter the trigger by using the timing input or by pressing the ◆ button in the RUN mode. The period that the timing signal is ON is the sampling period. **SELF-d** The sampling period is the period that the measured value is lower than the specified self-trigger level. **SELF-U** The sampling period is the period that the measured value is greater than the specified self-trigger level. **(For details, see page 93.)**
SMART MENU/SET		Press the MENU/SET button to apply the trigger conditions. (When SELF-U and SELF-d are selected, proceed to the next item, and when EI MI NG is selected, proceed to "7 Threshold setting.")	
Press to display.		Press the ▲ button to display SELFLV.	Default value: 0.000
		Press the ◆ button to enable setting of the self-trigger level.	
 [Change numeric value] [Move digit] Press to set.	Set any value.	Press the ◆◆ button to move the digit, press the ▲ button to change the numeric value, and set the self-trigger level.	* If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
 SMART MENU/SET		Press the MENU/SET button to apply the setting.	

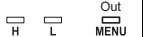
7 Threshold setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

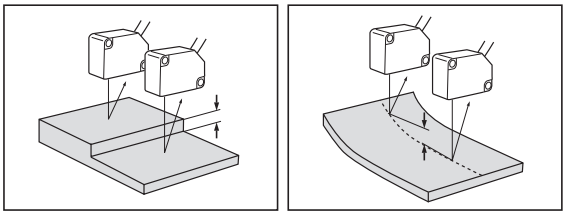
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display the HIGH threshold.	Setting example: Non-defective product height 0 to 10 mm  Set the MAX and MIN heights to be regarded as OK to the HIGH and LOW thresholds, respectively. * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
		Press the ◆ button to enable setting of the HIGH threshold.	
	 Set any value.	Press the ◆ button to move the digit, press the ◆ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	 Set any value.	Press the ◆ button to move the digit, press the ◆ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

8 Return to RUN mode Required

Switch to the mode in which measurement is performed.

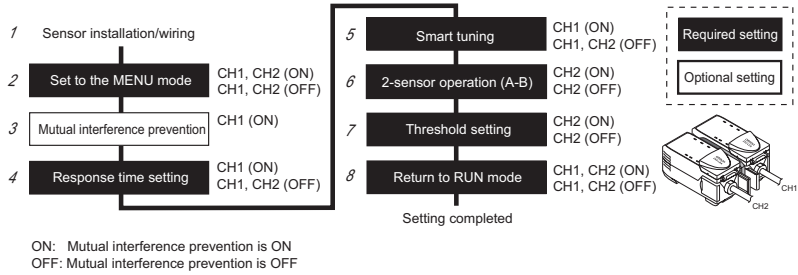
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "Detailed Settings." Example (Setting the reference height to 0 (or the offset value): **Zero Reset → page 97.**)



Procedure for setting up steps and warpage

The Amplifier Units to set up differ depending on whether mutual interference prevention is set to ON or OFF.
Note that different channels are used to specify each menu item, as shown below.



ON: Mutual interference prevention is ON
OFF: Mutual interference prevention is OFF

1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Connect two Amplifier Units with a Calculating Unit in between. (The calculation result is displayed and output on the CH2 Amplifier Unit.)

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that each of the heights to be measured is near the measurement center distance, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

(Use CH1 and CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Lit MENU	Hold down the MENU/SET button for three seconds to switch to the MENU mode.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display dEtAIL.	
		Press the ▼ button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

3 Mutual interference prevention Optional

Set this item to prevent the influence of mutual interference between two Sensor Heads.

(Use CH1 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button on the CH1 Amplifier Unit to display SYNC.	Default value: OFF
		Press the ▼ button to display ON.	
		Press the MENU/SET button to apply the setting.	* For details on the response time when connecting two or more Amplifier Units, see page 82.

4 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

If mutual interference prevention is ON: Use CH1 for these settings.
If mutual interference prevention is set to OFF: Use CH1 and CH2 for these settings.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display SPEEd.	Default value: 500 ms

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
		Press the button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

5 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

If mutual interference prevention is ON: Use CH1 for these settings.
If mutual interference prevention is set to OFF: Use CH1 and CH2 for these settings.

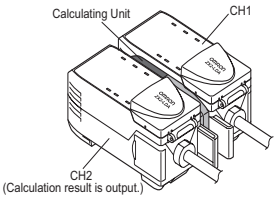
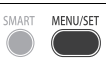
Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
Hold down for 1 second	Pressing down SMART SINGLE ↓ Pressed down TUNING SINGLE Flashing	Press the button for one second. When SMART1 SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again. * If mutual interference prevention is set to ON, after smart tuning execution for CH1 ends, it is also executed for the Amplifier Units of CH2 and later. If the tuning result is NG for either Amplifier Unit, the smart tuning setup results are not applied to any amplifier units.

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

6 2-sensor operation (A-B) Required

Set this item when calculating the difference between the measurement results from two Sensor Heads.

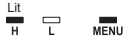
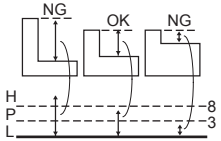
(Use CH2 for these settings.)

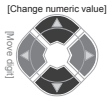
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button on the CH2 Amplifier Unit to display CALC.	
		Press the ◆ button to display A-b.	
		Press the MENU/SET button to apply the setting.	* For details on the response time when connecting two or more Amplifier Units, see page 82.

7 Threshold setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

(Use CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button on the CH2 Amplifier Unit to display the HIGH threshold.	Setting example: Non-defective product step 3 to 8 mm  Set the MAX and MIN steps to be regarded as OK to the HIGH and LOW thresholds, respectively.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to enable setting of the HIGH threshold.	* If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

8 Return to RUN mode Required

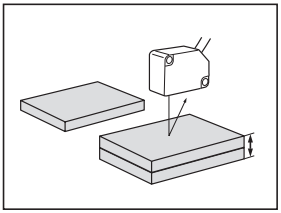
Switch to the mode in which measurement is performed.

(Use CH1 and CH2 for these settings.)

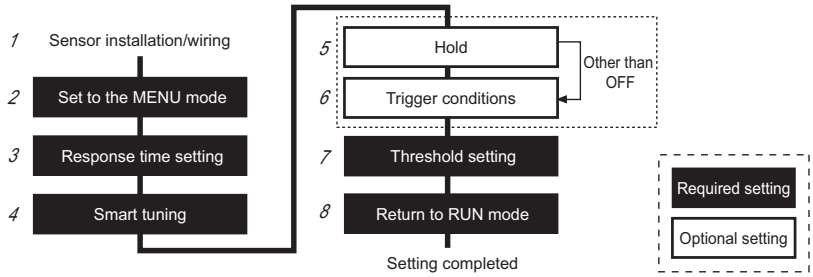
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

Double Sheet Detection



Procedure for setting up double sheet detection



1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the measured value at measurement of one product and at measurement of two products is within the measurement range, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This operation is not required when hold and trigger conditions are not to be set.
		Press the button to set the display to ON to set display of the detail menu.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

3 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	SPEEd 888888	Press the button to display SPEEd.	Default value: 500 ms
Press to select	SPEEd 1MS Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS 60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms
SMART MENU/SET		Press the MENU/SET button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
SMART MENU/SET Hold down for 1 second	Pressing down SMARt SI NGLE Pressed down tUNI NG SI NGLE Flashing	Press the SMART button for one second. When SMARt/ SI NGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILEd" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

5 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	HOLd	Press the ◆ button to display HOLd.	Default value: OFF
	HOLd PEAK Select the desired value.	Press the ◆ button to select the hold conditions.	OFF Hold OFF AVE The average measured value during the sampling period is held. P to P The difference between the minimum and maximum values during the sampling period is held. SAMPLE The measured value at the start of the sampling period is held. bOttOM The minimum value during the sampling period is held. PEAK The maximum value during the sampling period is held. **(For details, see page 91.)**
		Press the MENU/SET button to apply the setting. When other than OFF is selected, proceed to "6 Trigger conditions," and when OFF is selected, proceed to "7 Threshold setting."	* The clamp value is output until the first sampling period is finished. **(For details on the clamp value, see page 107.)**

6 Trigger conditions Optional

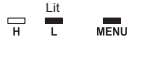
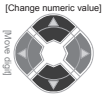
Set how timing of the hold measurement period is to be input.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	trIG	Press the ◆ button to display trIG.	Default value: TIMING

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the button to select the trigger conditions.	**TIMING** Enter the trigger by using the timing input or by pressing the button in the RUN mode. The period that the timing signal is ON is the sampling period. **SELF-d** The sampling period is the period that the measured value is lower than the specified self-trigger level. **SELF-U** The sampling period is the period that the measured value is greater than the specified self-trigger level. **(For details, see page 93.)**
SMART MENU/SET		Press the button to apply the trigger conditions. (When SELF-U and SELF-d are selected, proceed to the next item, and when TIMING is selected, proceed to "7 Threshold setting.")	
Press to display.		Press the button to display SELFLV.	Default value: 0.000
		Press the button to enable setting of the self-trigger level.	
[Change numeric value] [Move digit] Press to set.	Set any value.	Press the button to move the digit, press the button to change the numeric value, and set the self-trigger level.	* If the button is pressed when the cursor is at the right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.
SMART MENU/SET		Press the button to apply the setting.	

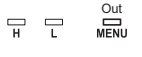
7 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

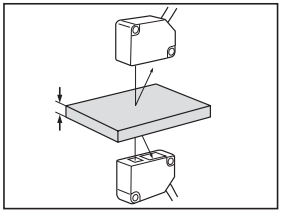
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display the HIGH threshold.	Examples: Set the HIGH and LOW thresholds right in the middle of the measured values of sheets 1 and 2 and sheets 1 and 0, respectively. * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
		Press the ◆ button to enable setting of the HIGH threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

8 Return to RUN mode Required

Switch to the mode in which measurement is performed.

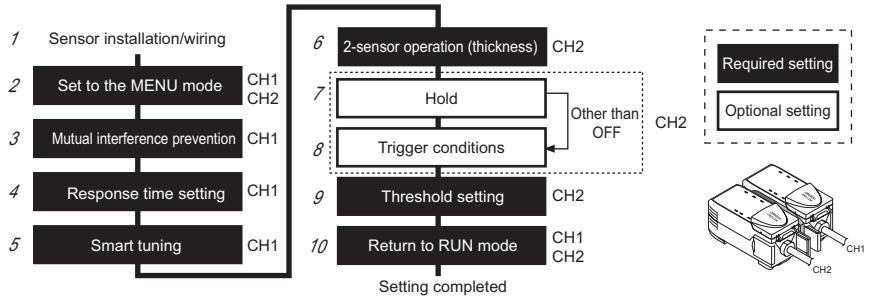
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "Detailed Settings." Example (Setting the reference height to 0 (or the offset value): **Zero Reset → page 97**)



Procedure for setting up thickness

The Amplifier Units to set up differ for each menu. Note also that different channels are used to specify each menu item, as shown below.



1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Connect two Amplifier Units with a Calculating Unit in between. (The calculation result is displayed and output on the CH2 Amplifier Unit.)

Set up the two Sensor Heads so that they are facing each other, adjust the positions of the Sensor Heads while looking at the digital display values on the Amplifier Units or the indicators on the Sensor Heads so that the clearance between the sensing object and each Sensor Head is near the measurement center distance, and install the Sensor Heads at these positions.

Prepare a reference sensing object of known thickness.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

(Use CH1 and CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Lit MENU	Hold down the MENU/SET button for three seconds to switch to the MENU mode.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display dEtAIL.	
		Press the ◆ button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

3 Mutual interference prevention Required

Set this item to prevent the influence of mutual interference between two Sensor Heads.

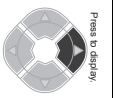
(Use CH1 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button on the CH1 Amplifier Unit to display SYNC.	Default value: OFF
		Press the ◆ button to display ON.	
		Press the MENU/SET button to apply the mutual interference prevention setting.	* For details on the response time when connecting two or more Amplifier Units, see page 82.

4 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

(Use CH1 for these settings.)

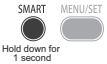
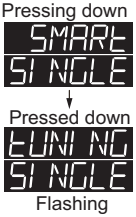
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button on the CH1 Amplifier Unit to display SPEEd.	Default value: 500 ms

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
		Press the button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

5 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

(Use CH1 for these settings.)

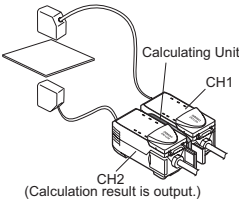
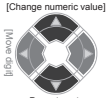
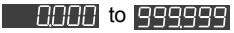
Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
 Hold down for 1 second	 Pressing down SMART SINGLE, Pressed down TUNING SINGLE, Flashing	Press the button on the CH1 Amplifier Unit for one second. When SMART/SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again. * After smart tuning execution for CH1 ends, it is also executed for the Amplifier Units of CH2 and later. If the tuning result is NG for either Amplifier Unit, the smart tuning setup results are not applied to any amplifier units.

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

6 2-sensor operation (thickness) Required

Make this initial setting to measure thickness when using two Sensor Head to measure thickness.

(Use CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Set the reference sensing object of which thickness is known in place.	
		Press the ▲ button on the CH2 Amplifier Unit to display CALC.	
		Press the ▲▼ button to display tHI CK.	
		Press the MENU/SET button to apply the thickness setting.	
	 Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the thickness numeric value.	 * If the ▲ button is pressed when the cursor is at the right-most digit or the ▼ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the MENU/SET button to apply the setting.	* The 2-sensor operation reference value is determined based on the measured values of CH1 and CH2 by the timing that setting of the thickness numeric values is executed. * For details on the response time when connecting two or more Amplifier Units, see page 82.

Important

- If analog output is to be used, the entered thickness value is used as the center value of the analog output range. (For example, 0 V is used if the analog output is ±5 V.)
- After thickness calculation, the maximum and minimum measurement range values (CH2 measurement values) are assigned as the maximum and minimum analog output range.
- Concerning the minimum and maximum analog output values, the analog output minimum value is output for the smaller of the post-thickkness calculation values, and the analog output maximum value is output for the larger of these values.

  Example: If the ZX2-LD50 is used, a thickness value of 20 mm is entered, and analog output from –5 to 5 V is specified.

Measured Value After Thickness Calculation	How the Measurement Value Is Calculated	Analog Output
10.000	Thickness value – (CH2 measurement range/2) = 20.000 – 10.000	–5 V
20.000	Thickness value = 20.000	0 V
30.000	Thickness value + (CH2 measurement range/2) = 20.000 + 10.000	5 V

* The measurement range for the ZX2-LD50 is ±10 mm.

7 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

(Use CH2 for these settings.)

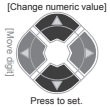
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button on the CH2 Amplifier Unit to display HOLd.	Default value: OFF
	Select the desired value.	Press the button to select the hold conditions.	OFF Hold OFF AVE The average measured value during the sampling period is held. P to P The difference between the minimum and maximum values during the sampling period is held. SAMPLE The measured value at the start of the sampling period is held. bOttOM The minimum value during the sampling period is held. PEAK The maximum value during the sampling period is held. **(For details, see page 91.)**
		Press the MENU/SET button to apply the setting. When other than OFF is selected, proceed to "7 Trigger conditions," and when OFF is selected, proceed to "9 Threshold setting."	* The clamp value is output until the first sampling period is finished. **(For details on the clamp value, see page 107.)**

8 Trigger conditions Optional

Set how timing of the hold measurement period is to be input.

(Use CH2 for these settings.)

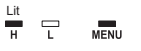
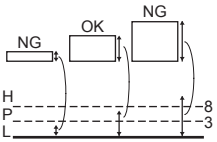
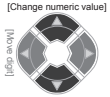
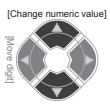
Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	trIG	Press the ▲ button on the CH2 Amplifier Unit to display trIG.	Default value: TIMING
Press to select	trIG tIMING Select the desired value.	Press the ▲▼ button to select the trigger conditions.	**tIMING** Enter the trigger by using the timing input or by pressing the ◀▶ button in the RUN mode. The period that the timing signal is ON is the sampling period. **SELF-d** The sampling period is the period that the measured value is lower than the specified self-trigger level. **SELF-U** The sampling period is the period that the measured value is greater than the specified self-trigger level. **(For details, see page 93.)**
SMART MENU/SET		Press the MENU/SET button to apply the trigger conditions. When SELF-U and SELF-d are selected, proceed to the next item, and when tIMING is selected, proceed to "9 Threshold setting."	
Press to display.	SELFLV	Press the ▲ button to display SELFLV.	Default value: 0.000
		Press the ◀▶ button to enable setting of the self-trigger level.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	 Set any value.	Press the ◆◆ button to move the digit, press the ▲▼ button to change the numeric value, and set the self-trigger level.	* If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the MENU/SET button to apply the setting.	

9 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

(Use CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button on the CH2 Amplifier Unit to display the HIGH threshold.	Setting example: Non-defective product thickness 3 to 8 mm  Set the MAX and MIN thicknesses to be regarded as OK to the HIGH and LOW thresholds, respectively. * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
		Press the ◆◆ button to enable setting of the HIGH threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ▲▼ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ▲▼ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

10 Return to RUN mode **Required**

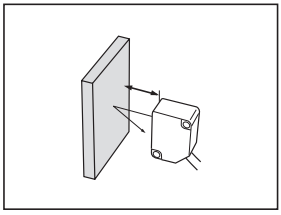
Switch to the mode in which measurement is performed.

(Use CH1 and CH2 for these settings.)

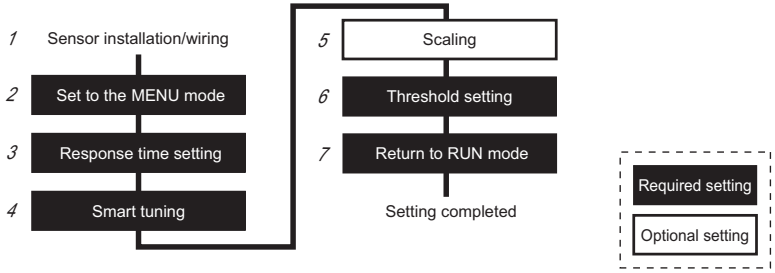
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS



Procedure for setting up positioning



1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Set the sensing object in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the upper and lower limits of the distance between the Sensor Head and the sensing object is within the measurement range, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This operation is not required when scaling is not to be set.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.		Press the button to set the display to ON to set display of the detail menu.	
SMART MENU/SET		Press the button to apply the setting.	

3 Response time setting **Required**

Select the response time to match the size and moving speed of the sensing object.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.		Press the button to display SPEEd.	Default value: 500 ms
Press to select	Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
SMART MENU/SET		Press the button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

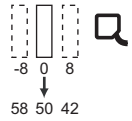
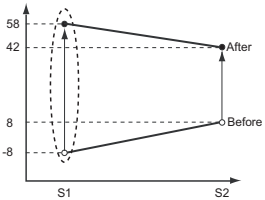
Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
	Pressing down SMART SINGLE ↓ Pressed down TUNING SINGLE Flashing	Press the SMART button for one second. When SMART/ SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

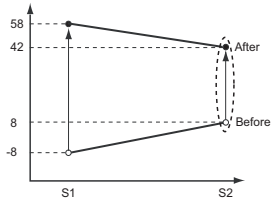
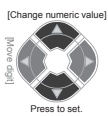
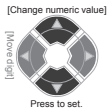
* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

5 Scaling Optional

Set this item to change the display scale when you want to display a digital value on the Amplifier Unit different from the actual measured value. (e.g. to display the actual sensing distance)

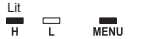
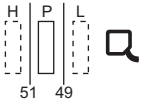
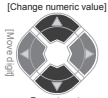
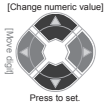
Button Operation	Display	Description of Operation	Explanation of Selection Menu
	SCALE 888888	Press the ◆ button to display SCALE.	Default value: OFF
	SCALE ON	Press the ◆ button to display ON.	
		Press the MENU/SET button to enable setting of scaling.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	S1-bEF -99999	Press the ◆ button to display S1-bEF.	<To display the actual sensing distance>   * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the ◆ button to enable setting of S1-Before.	
[Change numeric value] [Move digit] Press to set.	S1-bEF -8.000 [Numeric value before change] Set any value.	Press the ◆◆ button to move the digit, press the ▲ button to change the numeric value, and set the measured value before S1 is changed.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S1-Before.	
Press to display.	S1-AFt -99999	Press the ◆ button to display S1-AFt.	
		Press the ◆ button to enable setting of S1-After.	
[Change numeric value] [Move digit] Press to set.	S1-AFt 58.000 [Numeric value after change] Set any value.	Press the ◆◆ button to move the digit, press the ▲ button to change the numeric value, and set the measured value after S1 is changed.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S1-After.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display S2-bEF.	 * If the ▲ button is pressed when the cursor is at the right-most digit or the ▲ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the ◀▶ button to enable setting of S2-Before.	
	[Numeric value before change] Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value before S2 is changed.	
		Press the MENU/SET button to apply the numeric value of S2-Before.	
		Press the ▲ button to display S2-AFt.	
		Press the ◀▶ button to enable setting of S2-After.	
	[Numeric value after change] Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value after S2 is changed.	
		Press the MENU/SET button to apply the numeric value of S2-After.	

6 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display the HIGH threshold.	Setting example: Non-defective product position 49 to 51 mm  Set the positioning MAX and MIN distances to the HIGH and LOW thresholds, respectively. * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
		Press the ◆ button to enable setting of the HIGH threshold.	
	Set any value.	Press the ◆ button to move the digit, press the ◆ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	Set any value.	Press the ◆ button to move the digit, press the ◆ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

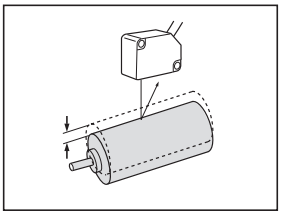
7 Return to RUN mode Required

Switch to the mode in which measurement is performed.

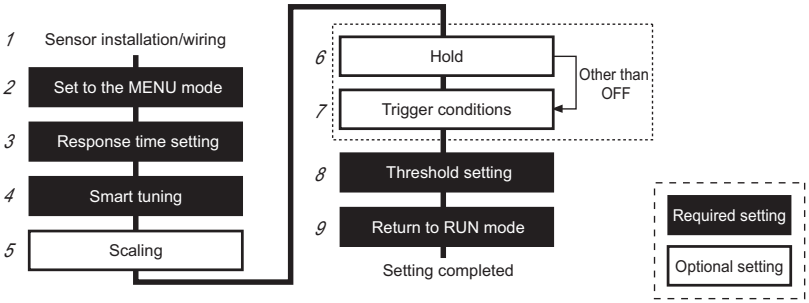
Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

Eccentricity and Surface Deflection



Procedure for setting up eccentricity and surface deflection



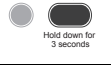
1 Sensor installation/wiring Required

Has the Sensor been installed and wired? **(See page 23.)**

Set the sensing object in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the clearance between the Sensor Head and the sensing object is near the measurement center distance, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This operation is not required when scaling, hold and trigger conditions are not to be set.
		Press the button to set the display to ON to set display of the detail menu.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

3 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	SPEEd	Press the button to display SPEEd.	Default value: 500 ms
Press to select	SPEEd 1MS Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
SMART MENU/SET		Press the MENU/SET button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

4 Smart tuning Required

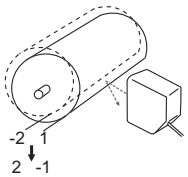
Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

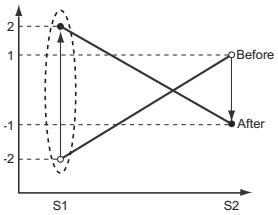
Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Check that the reference workpiece is set in place.	
SMART MENU/SET Hold down for 1 second	Pressing down SMARt SI NGLE Pressed down tUNI NG SI NGLE Flashing	Press the SMART button for one second. When SMARt/ SI NGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAI LEd" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 78**

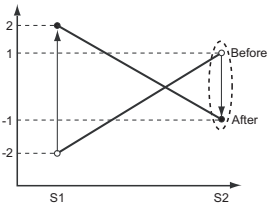
5 Scaling Optional

Set this item to change the display scale when you want to display a digital value on the Amplifier Unit different from the actual measured value. (e.g. to reverse the - and + indications)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	SCALE	Press the ▲ button to display SCALE.	Default value: OFF
Press to display.	SCALE ON	Press the ▼ button to display ON.	
SMART MENU/SET		Press the MENU/SET button to enable setting of scaling.	
Press to display.	S1-bEF	Press the ▲ button to display S1-bEF.	To set the NEAR and FAR sides as - and + indications to the sensor: 
		Press the ▼ button to enable setting of S1-Before.	
[Change numeric value] [Move digit] Press to set.	S1-bEF -2.000	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value before S1 is changed. [Numeric value before change] Set any value.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S1-Before.	
Press to display.	S1-AFt	Press the ▲ button to display S1-AFt.	
		Press the ▼ button to enable setting of S1-After.	
[Change numeric value] [Move digit] Press to set.	S1-AFt 2.000	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value after S1 is changed. [Numeric value after change] Set any value.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S1-After.	



* If the ▲ button is pressed when the cursor is at the right-most digit or the ▲ button is pressed when the cursor is at the left-most digit, the setting will be canceled.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	S2-bEF -99.999	Press the ◆ button to display S2-bEF.	 * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the ◆ button to enable setting of S2-Before.	
[Change numeric value] [Move digit] Press to set.	S2-bEF 1.000 [Numeric value before change] Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the measured value before S2 is changed.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S2-Before.	
Press to display.	S2-AFt -99.999	Press the ◆ button to display S2-AFt.	
		Press the ◆ button to enable setting of S2-After.	
[Change numeric value] [Move digit] Press to set.	S2-AFt - 1.000 [Numeric value after change] Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the measured value after S2 is changed.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S2-After.	

6 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

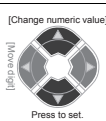
Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	HOLd 888888	Press the ◆ button to display HOLd.	Default value: OFF

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	HOLd PEAK Select the desired value.	Press the button to select the hold conditions.	OFF Hold OFF AVE The average measured value during the sampling period is held. P to P The difference between the minimum and maximum values during the sampling period is held. SAMPLE The measured value at the start of the sampling period is held. bOttOM The minimum value during the sampling period is held. PEAK The maximum value during the sampling period is held. **(For details, see page 91.)**
SMART MENU/SET		Press the button to apply the setting. When other than OFF is selected, proceed to "7 Trigger conditions," and when OFF is selected, proceed to "8 Threshold setting."	* The clamp value is output until the first sampling period is finished. **(For details on the clamp value, see page 107.)**

7 Trigger conditions Optional

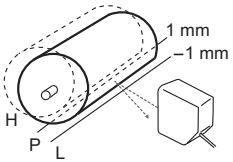
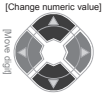
Set how timing of the hold measurement period is to be input.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	trIG 888888	Press the button to display trIG.	Default value: TIMING

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the ▲▼ button to select the trigger conditions.	**TIMING** Enter the trigger by using the timing input or by pressing the ◀▶ button in the RUN mode. The period that the timing signal is ON is the sampling period. **SELF-d** The sampling period is the period that the measured value is lower than the specified self-trigger level. **SELF-U** The sampling period is the period that the measured value is greater than the specified self-trigger level. **(For details, see page 93.)**
		Press the MENU/SET button to apply the trigger conditions. (When SELF-U and SELF-d are selected, proceed to the next item, and when TIMING is selected, proceed to "8 Threshold setting.")	
Press to display.		Press the ◀ button to display SELFLV.	Default value: 0.000
		Press the ◀▶ button to enable setting of the self-trigger level.	
 [Change numeric value] [Move digit] Press to set.	Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the self-trigger level.	* If the ◀ button is pressed when the cursor is at the right-most digit or the ▶ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the MENU/SET button to apply the setting.	

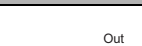
8 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display the HIGH threshold.	Setting example: Non-defective product eccentricity -1 to 1 mm  Set the eccentricity MAX and MIN distances to be regarded as OK to theHIGH and LOW thresholds, respectively. * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
		Press the ◆ button to enable setting of the HIGH threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the HIGH threshold.	
		Press the MENU/SET button to apply the setting.	
		Press the ◆ button to display the LOW threshold.	
		Press the ◆ button to enable setting of the LOW threshold.	
	 Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the LOW threshold.	
		Press the MENU/SET button to apply the setting.	

9 Return to RUN mode Required

Switch to the mode in which measurement is performed.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

DETAILED SETTINGS

Smart Tuning 78
(Optimizing the Sensing Conditions)

Connecting Two or More Amplifier Units 82

Mutual Interference Prevention 84

Setting the Hysteresis 87
(Improving Unstable Measurement Near the Judgement Threshold)

Setting the Hold Function 89
(Holding Measured Values Under Special Conditions)

Bank Setting 95

Zero Reset 97

Scaling 101
(Changing Digital Values for Specific Measured Values)

Analog Output 105

Output for Non-measurement 107
(Output Setting During Input of the Reset Signal at an Error)

Timer 110

Setting the Differential Function 112

External Input for Bank, Timing Input, Reset Input 114

Setting the Detection Surface Selection 116
(Decreasing Incorrect Measurement Caused by Multireflection on Workpiece)

Key Lock Function 118

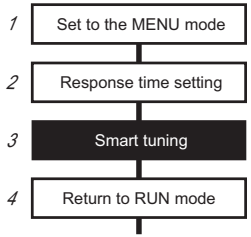
Initializing Settings Data 119

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

Smart tuning:

This setting option sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece).

Procedure for setting up smart tuning



* Steps 1, 2 and 4 are not required when the response time setting is completed since smart tuning can be performed even in the RUN mode.

Required setting

Optional setting

Important

- When connecting two or more Amplifier Units and mutual interference prevention is set to ON, use the CH1 Amplifier Unit to execute tuning. After smart tuning execution for CH1 ends, it is also executed for the Amplifier Units of CH2 and later.
  If the tuning result is NG for either Amplifier Unit, the smart tuning setup results are not applied to any amplifier units.

1 Set to the MENU mode Optional

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	

2 Response time setting Optional

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display SPEEd.	Default value: 500 ms

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	Select the desired value.	Press the button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60US to 500MS (60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms)
		Press the button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.

3 Smart tuning **Required**

Select from one of the following three methods to execute smart tuning:

(1) Tuning of a single stationary workpiece: Single smart tuning

(2) Tuning of multiple stationary workpieces: Multi-smart tuning
(a mix of workpieces having different color and state)

(3) Tuning of workpieces having different surface states: Active smart tuning
(execution of tuning while workpieces are moving)

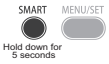
(1) Tuning of a single stationary workpiece: Single smart tuning

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Set the reference workpiece in place.	
Hold down for 1 second	Pressing down Pressed down Flashing	Press the button for one second. When SMART1 SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

(2) Tuning of multiple stationary workpieces: Multi-smart tuning (a mix of workpieces having different color and state)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Set reference workpiece 1 in place.	
	Pressing down Pressed down Flashing	Press the SMART button for three seconds. When SMART / MULTI is displayed, release your finger from the button to start execution of smart tuning.	* SMART / SINGLE is displayed for one to three seconds after the button is pressed, and then SMART / MULTI is displayed. If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.
—	—	Swap the workpiece with reference workpiece 2 and set it in place.	
	Pressing down Pressed down Flashing	Press the SMART button for three seconds. When SMART / MULTI is displayed, release your finger from the button to start execution of smart tuning. When there are three or more reference workpieces, swap each workpiece and repeat the procedure.	The optimum conditions are set for either reference workpiece 1 or 2 is set. * SMART / SINGLE is displayed for one to three seconds after the button is pressed, and then SMART / MULTI is displayed. If you release your finger from the button SMART / SINGLE, the result of tuning workpiece 1 will not be reflected. If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

(3) Tuning of workpieces having different surface states: Active smart tuning (execution of tuning while workpieces are moving)

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	Pressing down SMART ACTIVE Pressed down TUNING ACTIVE Flashing	Press the SMART button for five seconds with the workpiece set in place. When SMART/ ACTIVE is displayed, release your finger from the button to start execution of smart tuning. Because the execution of smart tuning continues, move the workpiece.	* SMART/SINGLE and SMART/MULTI are displayed for one to five seconds after the button is pressed, and then SMART/ ACTIVE is displayed.
		At the end of the desired tuning period, press the SMART button again for 5 to end tuning.	The optimum setting conditions will be set. If "FAILED" flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.

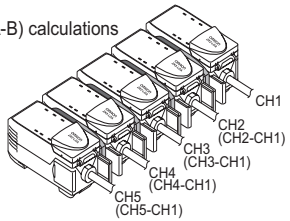
4 Return to RUN mode Optional

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Connecting Two or More Amplifier Units

Use a Calculating Unit to connect Amplifier Units when performing calculations between Amplifier Units and to prevent mutual interference between Sensor Heads.

The number of Amplifier Units that can be connected differs depending on the functions to be used.

Function	Number of Connectable Amplifier Units	See:
Calculation	Up to two units (Up to five units can be connected. However, calculations are done between pairs of two.) For (A-B) calculations  	(A-B) calculation: Page 45 Thickness calculation: Page 55
Mutual interference prevention	Up to five units	Page 84

Important

- Supply power to all connected Amplifier Units at the same time.
- When connecting two or more Amplifier Units, the response times (maximum values) are as follows:

Mutual Interference Prevention	Two-Sensor Operation	Total Response Time
OFF	OFF	Response time setting for each CH
	(A – B), THICK	(Total response time setting for each CH) + (4 ms × number of connected units)
ON	OFF	(Response time per unit in the table below) × number of connected units
	(A – B), THICK	

<Response time if mutual interference prevention is set to ON>

CH1 Response Time Setting	Response Time per Unit
60 µs	3 ms
120 µs	3 ms
240 µs	3 ms
500 µs	4 ms
1 ms	8 ms
2 ms	16 ms
4 ms	32 ms
8 ms	64 ms
12 ms	72 ms
20 ms	80 ms
36 ms	100 ms
66 ms	160 ms
128 ms	280 ms
250 ms	520 ms
500 ms	1 s

The displayed and set up menus differ depending on the channel when two or more Amplifier Units are connected and when mutual interference prevention is set to ON.

Use the Amplifier Units of the corresponding channel numbers to specify settings by referring to the tables below.

<Menus and setting channels when two or more Amplifier Units are connected>

Menu	CHs Used to Specify Settings	CHs Not Used to Specify Settings	Notes
Mutual interference prevention SYNC	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	The setting of CH1 is also applied to Amplifier Units of CH2 and later.
Two-sensor operation setting CALC Thickness setting tHI CK	CH2 to CH5	CH1: This cannot be used. (The setting menu is not displayed on the digital display.)	
Bank switching setting bANK	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	• The Amplifier Units of CH2 and later are switched together with CH1. (Bank registration is possible for individual amplifier units.) • Also use CH1 to switch the banks by means of an external input.
Initialization INIt	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	The Amplifier Units of CH2 and later are initialized together with CH1.

<Menus and setting channels when mutual interference prevention is set to ON>

Menu	CHs Used to Specify Settings	CHs Not Used to Specify Settings	Notes
Response time setting SPEEd	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	The setting of CH1 is also applied to Amplifier Units of CH2 and later.
Smart tuning	CH1	CH2 to CH5: Smart tuning cannot be executed for these separately.	Smart tuning for the Amplifier Units of CH2 and later are executed together with CH1.

(For details on the setup procedure when mutual interference prevention is set to ON, see the next page.)

CONTENTS

INTRODUCTION

PREPARATION FOR MEASUREMENT

FLOW OF OPERATION

BASIC SETUP

MAIN APPLICATIONS & SETTING METHODS

Height

Steps and Warpage

Double Sheet Detection

Thickness

Positioning

Eccentricity and Surface Deflection

DETAILED SETTINGS

TROUBLE-SHOOTING

SPECIFI-CATIONS

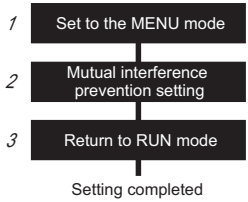
INDEX

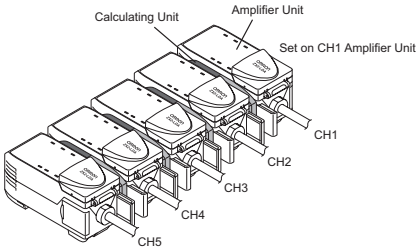
SETTING TRANSITION CHARTS

Mutual interference prevention:

This refers to the function for preventing the influence of Sensor Heads when mounted close to each other. (This function can be used for up to five Amplifier Units connected by using Calculating Units (ZX2-CAL).)

Procedure for setting up mutual interference prevention





1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET (Hold down for 3 seconds)	H L Lit MENU	Hold down the MENU/SET button of the CH1 Amplifier Unit for three seconds to switch to the MENU mode.	
Press to display.	dEtAIL	Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Press to display.	dEtAIL ON	Press the button to set the display to ON to set display of the detail menu.	
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

2 Mutual interference prevention setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display SYNC.	Default value: OFF
		Press the ▼ button to display ON.	
		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Important

- When CH1 is used to specify a setting while mutual interference prevention is set to ON, the menus for which the same setting is applied to the Amplifier Units of CH2 and later are shown in the following table.
  Specify settings for the menus in the following table after setting mutual interference prevention to ON.

Menu	Displayable and Specifiable CH Number	Notes
Response time setting SPEEd	CH1	The setting of CH1 is also applied to Amplifier Units of CH2 and later.
Smart tuning	CH1	Smart tuning for the Amplifier Units of CH2 and later are executed together with CH1.

- When connecting two or more Amplifier Units, the response times (maximum values) are as follows:

Mutual Interference Prevention	Two-Sensor Operation	Total Response Time
OFF	OFF	Response time setting for each CH
	(A – B), THICK	(Total response time setting for each CH) + (4 ms × number of connected units)
ON	OFF	(Response time per unit in the table below) × number of connected units
	(A – B), THICK	

<Response time if mutual interference prevention is set to ON>

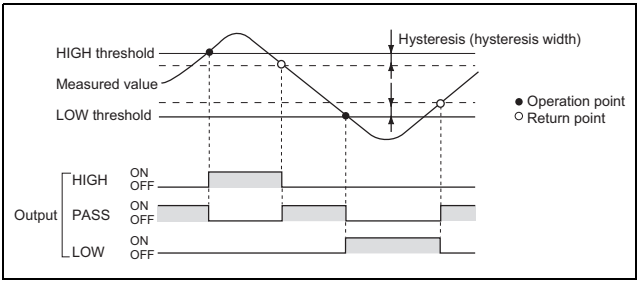
CH1 Response Time Setting	Response Time per Unit
60 µs	3 ms
120 µs	3 ms
240 µs	3 ms
500 µs	4 ms
1 ms	8 ms
2 ms	16 ms
4 ms	32 ms
8 ms	64 ms
12 ms	72 ms
20 ms	80 ms
36 ms	100 ms
66 ms	160 ms
128 ms	280 ms
250 ms	520 ms
500 ms	1 s

Setting the Hysteresis

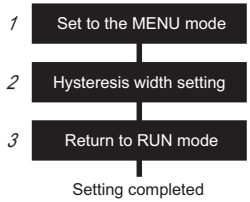
Setting channels used when connecting multiple units: Each CH

Hysteresis width:

This refers to the difference between the operation point and return point. Set the hysteresis width for the upper and lower limits of the judgements if the HIGH, PASS or LOW judgement is unstable near the threshold values.



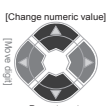
Procedure for setting up the hysteresis width



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Lit MENU	Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
Press to display.	dETAIL	Press the ▲ button to display dETAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Press to display.	dETAIL ON	Press the ▼ button to set the display to ON to set display of the detail menu.	
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

2 Hysteresis width setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display HYS .	Default value: 0.000
		Press the ◆ button to enable setting of the hysteresis width.	
	Set any value.	Press the ◆◆ button to move the digit, press the ◆ button to change the numeric value, and set the hysteresis width.	* If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Important

- The hysteresis width for HIGH, PASS or LOW judgment is disabled when the hold function is enabled.
- The hysteresis width is enabled when the self-trigger is set.

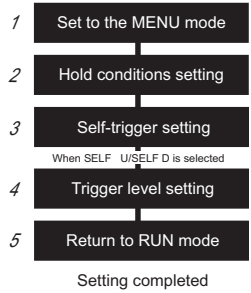
Setting the Hold Function

Setting channels used when connecting multiple units: Each CH

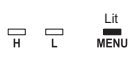
Hold:

The hold function holds any values during the measurement period, and outputs these values at the end of measurement.

Procedure for setting up hold

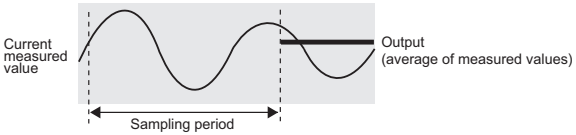
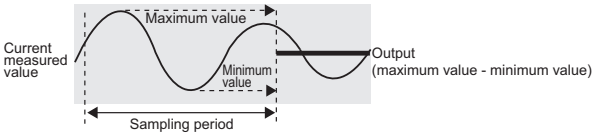
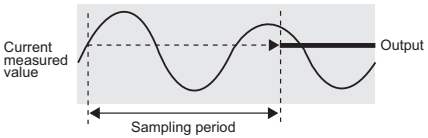
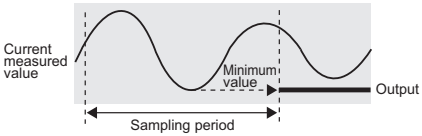
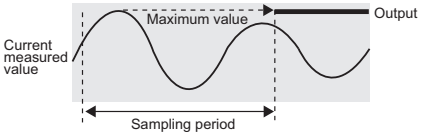


1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

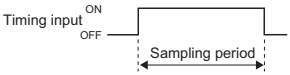
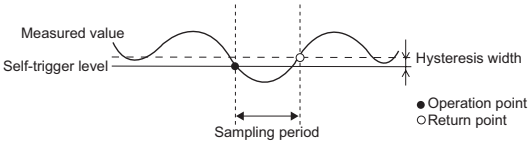
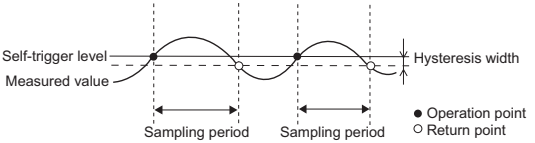
2 Hold conditions setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display HOLd.	Default value: OFF
Select the desired value.		Press the ◆ button to select the hold conditions.	OFF Hold OFF AVE The average measured value during the sampling period is held. P to P The difference between the minimum and maximum values during the sampling period is held. SAMPLE The measured value at the start of the sampling period is held. bOttOM The minimum value during the sampling period is held. PEAK The maximum value during the sampling period is held. **(For details, see the following page.)**
		Press the MENU/SET button to apply the setting. When other than OFF is selected, proceed to "3 Self-trigger setting."	* The clamp value is output until the first sampling period is finished. **(For details on the clamp value, see page 107.)**

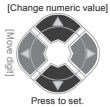
Selection menu	Details
OFF (default)	Hold measurement is not performed. The measured value is output at all times.
HOLd AVE	The average measured value during the sampling period is held. The output changes at the end of the sampling period and is held until the end of the next sampling period. 
HOLd P to P	The difference between the minimum and maximum values during the sampling period is held. This option is selected mainly to detect vibration. The output changes at the end of the sampling period and is held until the end of the next sampling period. 
HOLd SAMPLE	The measured value at the start of the sampling period is held. The output changes at the end of the sampling period and is held until the end of the next sampling period. 
HOLd bOttOM	The minimum value during the sampling period is held. The output changes at the end of the sampling period and is held until the end of the next sampling period. 
HOLd PEAK	The maximum value during the sampling period is held. The output changes at the end of the sampling period and is held until the end of the next sampling period. 

3 Self-trigger setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display trIG.	Default value: TIMING
	Select the desired value.	Press the ◆ button to select the self-trigger.	**EI MI NG** Enter the trigger by using the timing input or by pressing the ◆ button in the RUN mode. The period that the timing signal is ON is the sampling period. **SELF-d** The sampling period is the period that the measured value is lower than the specified self-trigger level. **SELF-U** The sampling period is the period that the measured value is greater than the specified self-trigger level. **(For details, see the following page.)**
		Press the MENU/SET button to apply the self-trigger. When SELF-U and SELF-d are selected, proceed to the next item, and when EI MI NG is selected, proceed to "5 Return to RUN mode."	

Selection menu	Details
TRIG TIMING (Default)	Either input the timing signal from an external device, or enter the trigger for starting sampling by pressing the button. The period that the timing signal is ON is the sampling period.  **(For details on external inputs, see page 114.)**
TRIG SELF-d	The sampling period is the period that the measured value is lower than the specified self-trigger level. Hold measurement is possible without a sync input. 
TRIG SELF-U	The sampling period is the period that the measured value is greater than the specified self-trigger level. Hold measurement is possible without a sync input. 

4 Trigger level setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	SELFLV 000000	Press the button to display SELFLV.	Default value: 0.000
		Press the button to enable setting of the self-trigger level.	
	SELFLV 99999 Set any value.	Press the button to move the digit, press the button to change the numeric value, and set the self-trigger level.	* If the button is pressed when the cursor is at the right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the MENU/SET button to apply the setting.	

5 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Bank Setting

Setting channels used when connecting multiple units
Bank switching: CH1
Bank registration: Each CH

Bank setting:

Up to four sets of settings can be stored in memory. (Default: bank 0) This is recommended, for example, when measuring on multi-lot lines.

Procedure for setting up banks

1. Set to the MENU mode
2. Bank switching
3. Various settings
4. Return to RUN mode

Setting completed

The following menu settings can be registered to banks:

HIGH threshold
LOW threshold
Response time
Hysteresis width
Measured value display scaling Pre-scaling display value 1 Post-scaling display value 1 Pre-scaling display value 2 Post-scaling display value 2
Self-trigger level
Display during zero reset

Important

- When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for switching. The Amplifier Units of CH2 and later are switched together with CH1.

1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Lit MENU	Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
Press to display.	dEtAIL	Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Press to display.	dEtAIL ON	Press the button to set the display to ON to set display of the detail menu.	
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

2 Bank switching

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display bANK.	Default value: 0
	Select the desired value.	Press the ▲▼ button to select the bank.	0 to 3
		Press the MENU/SET button to apply the setting.	

3 Various settings

Set the various menu items that require setting.

Execute smart tuning for each bank to be used because the smart tuning results are not applied to other banks.

4 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

The following explains how to switch banks and perform measurement.

Either switch banks by following the steps 1 → 2 → 4 described above, or input the required signal from an external device to switch the bank.

(For details on external inputs, see page 114.)

Zero Reset

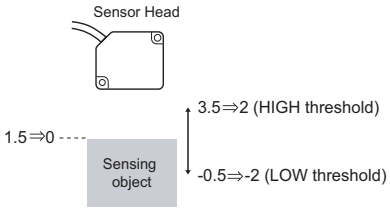
Setting channels used when connecting multiple units: Each CH

Zero reset:

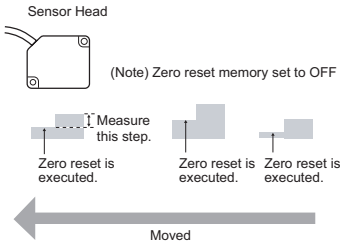
This refers to setting the reference value to "0" or any desired numeric value so that the measured value can be displayed and output as a positive or negative deviation (tolerance) from the reference value. The measured value can be set to "0" or any desired numeric value at any timing in the RUN mode.

Examples:

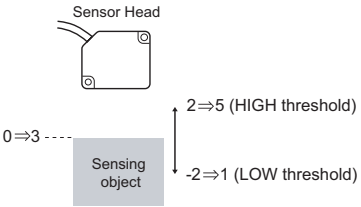
■ To eliminate reference deviation



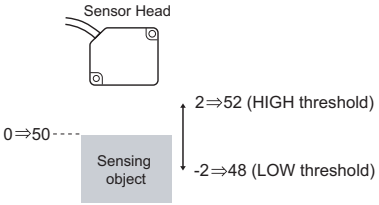
■ To measure steps in a sensing object by a single sensor (Executing a zero reset at each measurement)



■ To display the height of a workpiece



■ To display the actual measuring distance value



Procedure for setting up zero reset

1. Set to the MENU mode
2. Zero reset memory setting
3. Display setting at zero reset
4. Return to RUN mode
5. Zero reset execution

Setting completed

1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 Zero reset memory setting

Select whether or not to hold the measured value after the zero reset was performed when the power is turned OFF.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display ZRMEM.	Default value: OFF
	Select the desired value.	Press the button to select the zero reset memory setting.	ON Saves the current measured result. OFF Does not save the current measured result. When executing a zero reset at each measurement, set to OFF.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

Important

- If zero reset memory is set to ON, the zero reset level will be written in the Amplifier Unit's non-volatile memory (EEPROM) each time a zero reset is executed.
  The EEPROM can be written a maximum of 100,000 times. Writing the zero reset level for each measurement can, therefore, use up the life of the memory and lead to malfunctions.

3 Display setting at zero reset

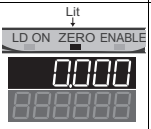
Set the zero reset memory function to set the reference value to any numeric value.

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	ZR.dI SP 000000	Press the ▲ button to display ZR.dI SP.	Default value: 0.000
		Press the ◀▶ button to enable setting of values at a reset.	
[Change numeric value] [Move digit] Press to set.	ZR.dI SP 99999 Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the offset level.	* If the ▲ button is pressed when the cursor is at the right-most digit or the ▲ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

4 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Out MENU	Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

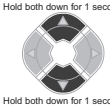
5 Zero reset execution

Button Operation	Display	Description of Operation	Explanation of Selection Menu
—	—	Set the sensing object to be used for executing the zero reset.	
Hold both down for 1 second		Either press the button for one second in the RUN mode, or input the zero reset signal (4 ms to 1 s) from an external device.	**(For details on external inputs, see page 114.)**

Important

- The minimum display value is –99.999, and the maximum display value is 999.999. If the measured value is below the minimum value after execution of zero reset, –99.999 will be displayed. 999.999 will be displayed if the measured value is above the maximum value.
  Zero reset can be executed only if the measured value is within ±10% of the rated measurement range.
- Even if a zero reset is executed, the threshold does not change from the setting before execution of the zero reset.
  (For example, even if a zero reset is executed so that measured value 2 become 0, the HIGH threshold stays at 5 if it is 5 before zero reset is executed.)

Procedure for canceling a zero reset

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Hold both down for 1 second  Hold both down for 1 second		Either press the button for one second in the RUN mode, or input the zero reset signal (3 s or more) from an external device.	

Scaling

Setting channels used when connecting multiple units: Each CH

Scaling:

The display scale can be changed when you want to display a digital value on the Amplifier Unit different from the actual measured value. (For example, when you want to set the measured value as the actual measuring distance.)

Procedure for setting up scaling

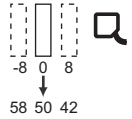
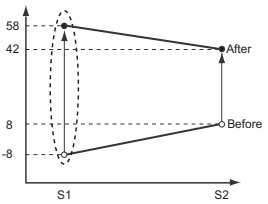
1 Set to the MENU mode
2 Scaling
3 Return to RUN mode
Setting completed

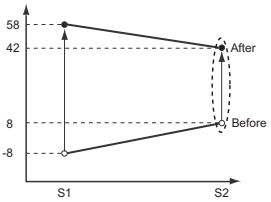
1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 Scaling

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display SCALE.	Default value: OFF

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	SCALE ON	Press the button to display ON.	
SMART MENU/SET		Press the button to enable setting of scaling.	
Press to display.	S1-bEF -99.999	Press the button to display S1-bEF.	<To display the actual sensing distance>   * If the button is pressed when the cursor is at the right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.
		Press the button to enable setting of S1-Before.	
[Change numeric value] [Move digit] Press to set.	S1-bEF -8.000	Press the button to move the digit, press the button to change the numeric value, and set the measured value before S1 is changed. [Numeric value before change] Set any value.	
SMART MENU/SET		Press the button to apply the numeric value of S1-Before.	
Press to display.	S1-AFt -99.999	Press the button to display S1-AFt.	
		Press the button to enable setting of S1-After.	
[Change numeric value] [Move digit] Press to set.	S1-AFt 58.000	Press the button to move the digit, press the button to change the numeric value, and set the measured value after S1 is changed. [Numeric value after change] Set any value.	
SMART MENU/SET		Press the button to apply the numeric value of S1-After.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to display.	S2-bEF -99.999	Press the ▲ button to display S2-bEF.	
		Press the ◀▶ button to enable setting of S2-Before.	
[Change numeric value] [Move digit] Press to set.	S2-bEF 8.000 [Numeric value before change] Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value before S2 is changed.	* If the ▲ button is pressed when the cursor is at the right-most digit or the ▲ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S2-Before.	
Press to display.	S2-AFt -99.999	Press the ▲ button to display S2-AFt.	
		Press the ◀▶ button to enable setting of S2-After.	
[Change numeric value] [Move digit] Press to set.	S2-AFt 42.000 [Numeric value after change] Set any value.	Press the ◀▶ button to move the digit, press the ▲▼ button to change the numeric value, and set the measured value after S2 is changed.	
SMART MENU/SET		Press the MENU/SET button to apply the numeric value of S2-After.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Out MENU	Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

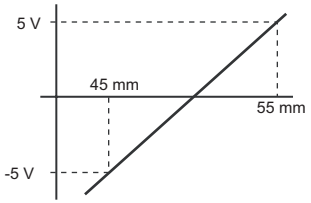
Important

- Analog output when specifying the scaling setting

  The analog output range is assigned based on the post-scaling display value setting range (between S1-AFT and S2-AFT).

  Concerning the minimum and maximum analog output values, the analog output minimum value is output for the smaller of the post-scaling display values (S1-AFT/S2-AFT), and the analog output maximum value is output for the larger of these values.

Example: To set the analog output in the range of –5 V to 5 V and display a value from 45 mm to 55 mm when using the ZX2-LD50(L) at a distance of 45 mm to 55 mm from the sensor:



(1) Select $-5.5V$ as the analog output setting.

(2) Specify the AFT value, and then assign the display value based on the measured value. Assign the analog output range based on the display value range.

- S1-BEF: –5 (mm)
- S1-AFT: 55 (mm)
- S2-BEF: 5 (mm)
- S2-AFT: 45 (mm)

<Initial setting>

Display value	Analog output
–10 mm	–5 V
10 mm	5 V

→

<Scaling setting>

Scaling point	Pre-scaling display value (BEF)	Post-scaling display value (AFT)	Analog output
S1	–5 mm	55 mm	5 V
S2	5 mm	45 mm	–5 V

- Threshold value when specifying the scaling setting

  Even if scaling is executed, the threshold does not change from the setting before execution of scaling. (For example, the HIGH threshold stays at 5 if it was 5 before scaling is executed.)

Analog Output

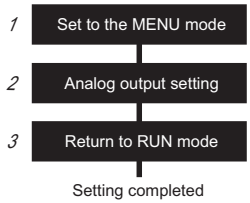
Setting channels used when connecting multiple units: Each CH

Analog output:

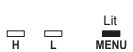
This refers to the conversion of measurement results to 4 to 20 mA current output or to -5 to +5 V/1 to 5 V voltage output.

The relationship between display values and analog output values can be freely specified. (Monitor focus)

Procedure for setting up analog output



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	

2 Analog output setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display A-OUT .	Default value: -5 to +5 V
	Select the desired value.	Press the button to select analog output.	4. 20MA Current output 4 to 20 mA Voltage output 1 to 5 V Voltage output 5 to +5 V
		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

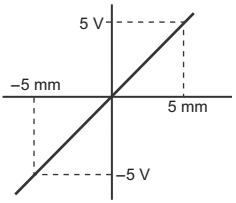
Freely specifying the relationship between display values and analog output values (equivalent to the former ZX-L-N monitor focus)

- To specify any analog output value for a display value, assign the analog output range and the minimum and maximum analog output values by selecting the analog output and then setting up scaling.
  (If scaling is not set up, the measurement range is the same as the analog output range.)

  The analog output range is assigned based on the post-scaling display value setting range (between S1-AFT and S2-AFT).
  Concerning the minimum and maximum analog output values, the analog output minimum value is output for the smaller of the post-scaling display values (S1-AFT/S2-AFT), and the analog output maximum value is output for the larger of these values.

- To only specify the analog output range, without changing display values

Example: To set the analog output in the range of –5 V to 5 V when using the ZX2-LD50(L) at a distance of 45 mm to 55 mm from the sensor:



(1) Select $-5.5V$ as the analog output setting.

(2) Specify the measurement range to use for the BEF and AFT values, and then assign the analog output range based on the measured value range.
- S1-BEF: –5 (mm)
- S1-AFT: –5 (mm) → Set the same value as S1-BEF
- S2-BEF: 5 (mm)
- S2-AFT: 5 (mm) → Set the same value as S2-BEF

<Initial setting>

Display value	Analog output
–10 mm	–5 V
10 mm	5 V

→

<Scaling setting>

Scaling point	Pre-scaling display value (BEF)	Post-scaling display value (AFT)	Analog output
S1	–5 mm	–5 mm	–5 V
S2	5 mm	5 mm	5 V

- To specify the analog output range after changing display values
  (For details on scaling, see page 104.)

Output for Non-measurement

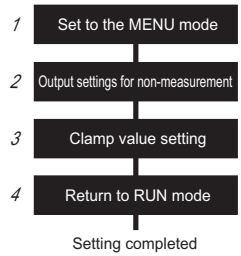
Output for non-measurement:

This refers to specifying the output contents when an error occurs (Error-dark or Error-bright), when a reset is being input, or before measured values are finalized.

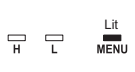
(For details on these errors, see page 126.)

Selection Menu	Output Contents	
	Judgment Output	Analog Output
KEEP (Default)	The measurement value immediately before the non-measurement state is entered is held and output.	
CLAMP	All OFF	The specified CLAMP value is output. The following options are available. • For voltage output: –5.00 to 5.00 V (in 1-V steps), or the maximum (approximately 5.5 V) • For current output: 4.00 to 20.00 mA (in 1-mA steps), or the maximum (approximately 22 mA)

Procedure for setting up output for non-measurement



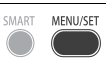
1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 Output settings for non-measurement

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display RSt.OUt.	Default value: KEEP
	Select the desired value.	Press the ▲▼ button to select output for non-measurement.	KEEP The measured value status before measurement is stopped is held and output. CLAMP Judgment output: All OFF Analog output: The preset clamp value is output.
		Press the MENU/SET button to apply the setting.	

3 Clamp value setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display CLAMP.	Default value: MAX The clamp value is output from when the power is turned on until the measured value is finalized, even when KEEP is selected, so be sure to set this value.
	Select the desired value.	Press the ▲▼ button to display the clamp value.	For voltage output: -5.00V to 5.00V In 1 V units MAX For current output: 400mA to 2000mA In 1 mA units MAX
		Press the MENU/SET button to apply the setting.	

4 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

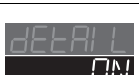
Timer:

The timing for judgement outputs can be adjusted to match the operation of external devices.

Procedure for setting up the timer

1 Set to the MENU mode
2 Timer setting
3 Return to RUN mode
Setting completed

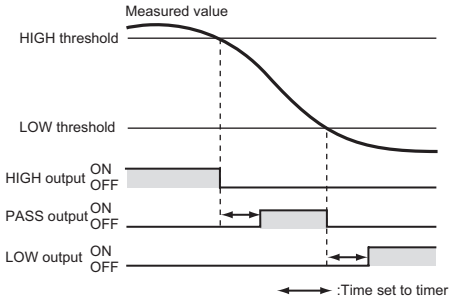
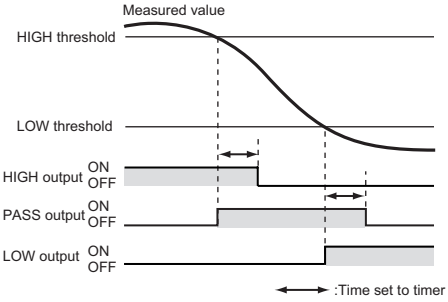
1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dETAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 Timer setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Select the desired value.		Press the button to display ONtIM when setting the ON-delay and OFFtIM when setting the OFF-delay.	ONtIM ON-delay timer OFFtIM OFF-delay timer **(For details, see the following page.)**
		Press the button to enable setting of the timer.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu
[Change numeric value] Move digit Press to set.		Press the ◆◆ button to move the digit, press the ▲▼ button to change the numeric value, and set the time set to the timer.	0MS to 1000MS * If the ◆ button is pressed when the cursor is at the right-most digit or the ◆ button is pressed when the cursor is at the left-most digit, the setting will be canceled.
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

Selection menu	Details
ONtIM (ON-delay timer)	After the measurement result has been finalized, the timer delays turning ON of the PASS output for the time set to the timer. 
OFFtIM (OFF-delay timer)	After the measurement result has been finalized, the timer delays turning OFF of the PASS output for the time set to the timer. 

3 Return to RUN mode

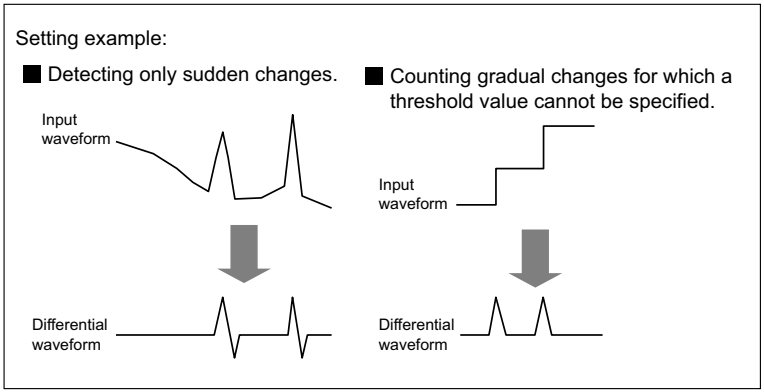
Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Out MENU	Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Setting the Differential Function

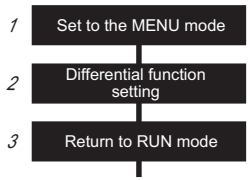
Setting channels used when connecting multiple units: Each CH

Differential function:

This function is used to specify the detection of only sudden changes in the measured values that occur during very short periods of time.



Procedure for setting up differential function



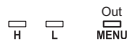
1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 Differential function setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ▲ button to display dI FF.	
		Press the ▼ button to set the display to ON.	
		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

CONTENTS

INTRODUCTION

PREPARATION FOR MEASUREMENT

FLOW OF OPERATION

BASIC SETUP

MAIN APPLICATIONS & SETTING METHODS

Height

Steps and Warpage

Double Sheet Detection

Thickness

Positioning

Eccentricity and Surface Deflection

DETAILED SETTINGS

TROUBLE-SHOOTING

SPECIFI-CATIONS

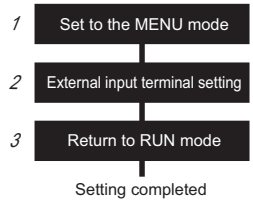
INDEX

SETTING TRANSITION CHARTS

External input:

This refers to inputting the bank switching signal, the timing signal during a hold and the reset signal from an external device to execute these operations.

Procedure for setting up external input



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
		Press the button to display dEtAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
		Press the button to set the display to ON to set display of the detail menu.	
		Press the MENU/SET button to apply the setting.	

2 External input terminal setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display EXt-IN.	Default value: TIM.RST

Button Operation	Display	Description of Operation	Explanation of Selection Menu
Press to select	EXT-IN EI MRSE Select the desired value.	Press the button to select the external input terminal.	EI MRSE timing input/reset input bANK Bank switching
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds	H L Out MENU	Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Procedure for executing external input

Each of the functions is executed when signals are input using the external input wire in table 1 below.

Timing input, reset input and bank switching are executed by a signal input of 4 ms or more. While the signal in table 2 below is being input, measurement is performed based on the settings of the specified bank.

When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for bank switching. The banks of the Amplifier Units of CH2 and later are switched together with CH1.

Table 1 External Input Wiring

Amplifier Unit Connector Cable Color / Setting	Purple	Red
EI MRSE	Timing input	Reset input
bANK	BANK input 0	BANK input 1

Table 2 Bank Signal Switching Wiring

	BANK Input 0 (purple)	BANK Input 1 (red)
BANK 0	OFF	OFF
BANK 1	ON	OFF
BANK 2	OFF	ON
BANK 3	ON	ON

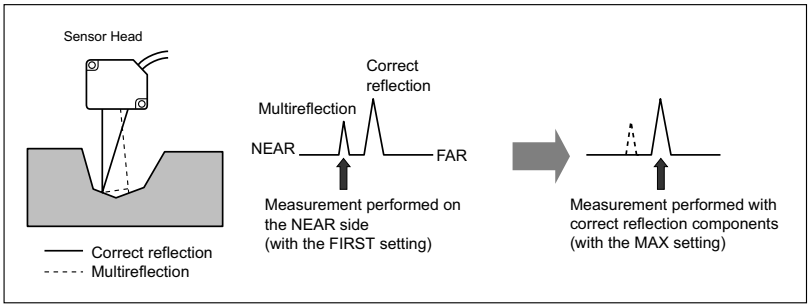
Note: Bank signal switching is enabled only in the RUN mode.

Setting the Detection Surface Selection

Setting channels used when connecting multiple units: Each CH

Detection surface selection:

The default value is FIRST. Setting the value to MAX can decrease incorrect measurements caused by diffused reflection or multireflection due to the shape of the workpiece.



Procedure for setting up detection surface selection

1 Set to the MENU mode

2 Detection surface selection setting

3 Return to RUN mode

Setting completed

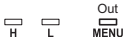
1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET (Hold down for 3 seconds)	H L Lit MENU	Hold down the MENU/SET button for three seconds to switch to the MENU mode.	
Press to display.	dETAIL	Press the button to display dETAIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Press to display.	dETAIL ON	Press the button to set the display to ON to set display of the detail menu.	
SMART MENU/SET		Press the MENU/SET button to apply the setting.	

2 Detection surface selection setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the ◆ button to display dEtECt.	
	Select the desired value.	Press the ◆ button to display MAx.	FIRSt During normal measurement MAx When an incorrect measurement occurs due to diffused reflection or multireflection
		Press the MENU/SET button to apply the setting.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

Key Lock Function

Setting channels used when connecting multiple units: Each CH

CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

Key Lock Function:

The key lock function disables all keys. Once keys have been disabled, no key input will be accepted until the lock is released. This function is useful for preventing inadvertent changes to settings.

Key Lock Function

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold both the ◆◆ buttons down for three seconds in the RUN mode.	

Canceling the Key Lock

Button Operation	Display	Description of Operation	Explanation of Selection Menu
	Displayed until completion of cancellation	Hold both the ◆◆ buttons down for three seconds in the RUN mode.	

Initializing Settings Data

Setting channels used when connecting multiple units: Each CH

Initialization: This function resets all settings to their default values.

Default Values

Function	Default Value
Display	0 reference: Measurement center distance + indication: NEAR side - indication: FAR side
HIGH threshold	Measurement range maximum value
LOW threshold	Measurement range minimum value
Response time	500 ms
Analog output setting	–5 to +5 V
Detail menu display selection	OFF
Bank switching settings	0
Mutual interference prevention	OFF
Hysteresis width	0.000
Two-Sensor operation setting	OFF
Thickness setting	0.000
Measured value display scaling	OFF
Differential function	OFF
Hold setting	OFF
Trigger mode	TIMING (self-trigger timing input)
Self-trigger level	0.000
Output for non-measurement	KEEP
Clamp value	MAX
ON-delay time	0 ms
OFF-delay time	0 ms
Zero reset memory	OFF
Display during zero reset	0.000
External input terminal setting	TIM.RST (timing input/reset input)
Detection surface selection	FIRST

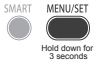
Procedure for initializing settings data

1 Set to the MENU mode
2 Setting data initialization
3 Return to RUN mode
Setting completed

Important

- When connecting two or more Amplifier Units, use CH1 to perform initialization because CH2 and later channels cannot be used to do this.
  Note that CH2 and later channels are initialized together with CH1.

1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the MENU mode.	

2 Setting data initialization

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Press the button to display INIt.	
		Press the button to display ExE.	
	Displayed 1 digit at a time	Press the MENU/SET button.	
		When OK is displayed, this means that initialization is completed.	

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
		Hold down the MENU/SET button for three seconds to switch to the RUN mode.	

MEMO

TROUBLESHOOTING

Troubleshooting	**124**
Error Messages	**126**
Q&A	**129**

Troubleshooting

This section describes countermeasures for temporary hardware problems. Check the malfunction in this section before sending the hardware for repair.

Category	Problem	Probable cause and possible countermeasure	Pages
Operation	The device restarts during operation.	• Is the power supply device connected correctly? • Are the Calculating Units connected correctly?	p.28 p.25
	No input signal is received.	• Are all cables connected correctly? • Is the input signal line disconnected?	p.28
	The measured values fluctuate and are not stable depending on day and time.	• This problem may be due to temperature characteristics. Execute zero reset periodically using the standard object to correct this problem.	p.97
	Laser light is not emitted.	• Is the LD-OFF input short-circuited?	p.28
	Bank switching by signals from the external input terminal is not functioning.	• Is the external input terminal set to bANK? • Is the cable connected correctly?	p.114 p.28
	The state returns to bANK 0 in the RUN mode even if after a bank is switched by button operation.	• Is the external input terminal set to EI MRSE ?	p.114
Display	The main display stays at [-----].	• Has a timing input been made while hold is enabled and the the trigger mode is EI MI NG ? • If the hold function is enabled and the trigger type is SELF-U or SELF-d, has the self-trigger level been set to an appropriate value?	p.89
	An abnormal distance is displayed when the object is clearly outside the measurement range.	• This problem may occur due to the characteristics of the sensor. Make sure that the distance to the sensing object is appropriate.	—
	LddOWN is displayed on the sub-display when the power is turned ON.	• The laser of the Sensor Head has deteriorated. Replace the Sensor Head.	—
	LdOFF is displayed on the sub-display.	• Is the LD-OFF input short-circuited?	p.28
	EI MI NG is displayed on the sub-display.	• Is the timing input short-circuited?	p.28
	RESEt is displayed on the sub-display.	• Is the reset input short-circuited?	p.28
	Even though the installation conditions are the same, measured values differ considerably.	• Is the zero-reset input short-circuited?	p.28

Category	Problem	Probable cause and possible countermeasure	Pages
Display	E-bRGt is displayed on the main display.	• Is the distance between the Sensor Head and the workpiece within the measurement range?	p.135
	E-dARK is displayed on the main display.	• Is the distance between the Sensor Head and the workpiece within the measurement range?	p.135
Output	Judgements are not output to external devices.	• Are all cables connected correctly? • Is the output signal line disconnected? • Is the reset input short-circuited? • Is the HIGH threshold set to a value larger than the LOW threshold?	p.28
	Analog output levels are strange.	• Are the analog output settings correct?	p.105

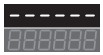
Error Messages

This section outlines the error messages displayed on the Amplifier Unit and the countermeasures for those messages.

While displaying an error, the error output signal is also output. (There are some exceptions.)

Display	Error	Countermeasure
Error-bright 	Saturated light amount intensity, measurement error. (The error output signal is not output.)	• Install so that the distance between the Sensor Head and the workpiece is within the measurement range.
Error-channel 	• There is only one Amplifier Unit even though mutual interference prevention is set to ON. • There is only one Amplifier Unit even though two-Sensor operation is set to ON.	• If two or more Amplifier Units have been installed, turn OFF the power supply and check that the Amplifier Units and Calculating Units are connected correctly. • If only one Amplifier Unit is being used, connect another Amplifier Unit temporarily and turn OFF mutual interference prevention and two-Sensor operation, or initialize the setting data.
Error-channel 	Two Amplifier Unit communications error.	
Error-dark 	Insufficient received light intensity, measurement error. (The error output signal is not output.)	• Install so that the distance between the Sensor Head and the workpiece is within the measurement range.
Error-head 	The Sensor Head is disconnected. Or, a sensor communications error has occurred.	• Turn OFF the power supply, check the Sensor Head connection, and then turn ON the power supply again. • If the above countermeasure does not solve the problem, the Sensor Head is malfunctioning. Replace the Sensor Head.
Error-head 		
Error-head 		
Error-head 	Sensor Head laser error.	
Error-head 	The Sensor Head internal memory is in error.	
Error-head 		

Display	Error	Countermeasure
Error-head Error-head Error-head	Sensor Head system error.	• Turn OFF the power supply, check the Sensor Head connection, and then turn ON the power supply again. • If the above countermeasure does not solve the problem, the Sensor Head is malfunctioning. Replace the Sensor Head.
Error-head	Because the Sensor Head version is old, the connected Amplifier Unit cannot be used.	• Contact the company with which your company is doing business or the OMRON sales representative handling your company.
Error-memory	Amplifier Unit setting memory error.	• Turn OFF the power supply, check if wiring is connected correctly, and then turn ON the power supply again. • If the above countermeasure does not solve the problem, the Amplifier Unit is malfunctioning. Replace the Amplifier Unit.
Error-memory	Amplifier Unit setting memory error.	• Initialize the settings by holding down the SET key for at least three seconds. • If the above countermeasure does not solve the problem, the Amplifier Unit is malfunctioning. Replace the Amplifier Unit.
Error-short	One or all of the judgment outputs are short-circuited.	• Turn OFF the power supply, check that the HIGH, PASS, LOW or error output lines are not short-circuited, then turn ON the power supply again.
Error-system	Amplifier Unit system error.	• Turn OFF the power supply, check if wiring is connected correctly, and then turn ON the power supply again. • If the above countermeasure does not solve the problem, the Amplifier Unit is malfunctioning. Replace the Amplifier Unit.
Tuning-failed	Smart Tuning failed. (The error output signal is not output.)	• Change the response time setting to a larger value, and try again. • Make sure that the distance between the Sensor and Workpiece is within the measurement range, and try again.

Display	Error	Countermeasure
LD.down	The laser of the Sensor Head has deteriorated.	• Replace the Sensor Head.
	Measured values are not output because the reset signal is being input, calculations are in progress, timing is before the hold sampling time, etc. (The error output signal is not output.)	• Normally, measured values are displayed once they can be output.

Question	Answer
What is the positional variation range with respect to the machine axis of the emitter beam spot?	The range is ±0.5° of the ideal emitter axis in the dimensional drawing on page 134.
After the response time is changed, is it necessary to re-execute smart tuning?	Yes. After the response time is changed, the smart tuning results are cleared. Therefore, re-execute tuning.
If using a different bank for the first time, is it necessary to execute smart tuning?	Yes. The smart tuning results are not applied to other banks. If using a different bank for the first time, execute smart tuning.
For the line beam type, is it possible to detect beam-spot-internal steps?	Spot-internal steps cannot be measured. Use the line beam spot so that it is at only one height.
Is it possible to add additional extension cables between the Sensor Head and Amplifier Unit?	Regardless of the length, only one extension cable can be added. It is not possible to add multiple extension cables.
About how much signal input and open time is required for each input operation?	These times can be checked using the timing charts in this manual (on page 137).
Can calculations be performed when Sensor Heads that have different measurement ranges are connected to two Amplifier Units?	Yes. This is possible without specifying any special settings.
How can I prevent an incorrect value being measured and output due to the shape of the workpiece?	If the incorrect measurement is caused by multireflection due to the shape of the workpiece, setting the detection surface selection to MAX might improve the measurement accuracy. (See page 116.)

MEMO

SPECIFICATIONS

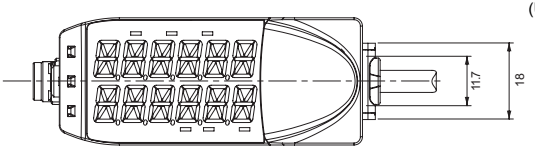
Specifications and Dimensions	**132**
Timing Charts	**137**
Engineering Data (Typical)	**140**

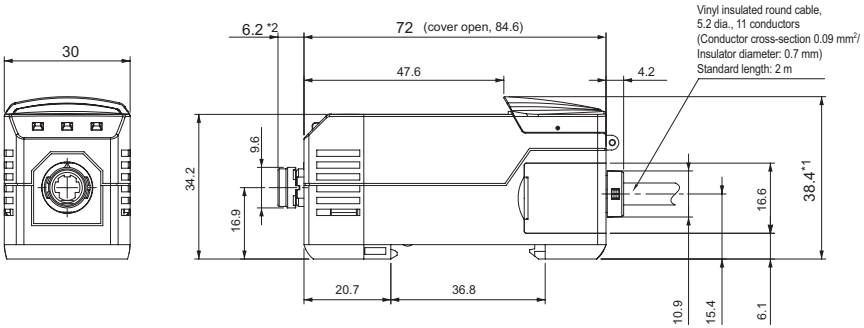
CONTENTS
INTRODUCTION
PREPARATION FOR MEASUREMENT
FLOW OF OPERATION
BASIC SETUP
MAIN APPLICATIONS & SETTING METHODS
Height
Steps and Warpage
Double Sheet Detection
Thickness
Positioning
Eccentricity and Surface Deflection
DETAILED SETTINGS
TROUBLE-SHOOTING
SPECIFI-CATIONS
INDEX
SETTING TRANSITION CHARTS

Amplifier Units

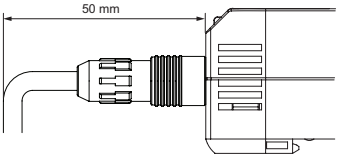
ZX2-LDA11/LDA41

(Unit: mm)





*1 Max. height when cover is open: 56
*2 Min. length when connected: 50



Item \ Model	ZX2-LDA11	ZX2-LDA41
Measurement period (*1)	Min. 30 µs	
Response time	60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	
Analog output (*2)	4 to 20 mA, Max. load resistance: 300 Ω, ±5 VDC or 1 to 5 VDC, Output impedance: 100Ω	
Judgment outputs (HIGH/PASS/ LOW: 3 outputs), error output	NPN open-collector outputs, 30 VDC, 50 mA max. residual voltage: 1 V max. for load current 10 mA max., 2 V max. for load current above 10 mA	PNP open-collector outputs, 30 VDC, 50 mA max. residual voltage: 1 V max. for load current 10 mA max., 2 V max. for load current above 10 mA
Laser OFF input, zero reset input, timing input, reset input, bank input	ON: Short-circuited with 0-V terminal or 1.2 V or less. OFF: Open (leakage current: 0.1 mA max.)	ON: Supply voltage short-circuited or supply voltage within –1.2 V OFF: Open (leakage current: 0.1 mA max.)
Functions	Smart tuning, scaling, sample hold, peak hold, bottom hold, peak-to-peak hold, self-peak hold, self-bottom hold, average hold, zero reset, On-delay timer, OFF-delay timer, keep/clamp switch, (A-B) calculations (*3), thickness calculation (*3), mutual interference prevention (*3), laser deterioration detection, bank function (4 banks)	
Indications	Judgement indicators: HIGH (orange), PASS (green), LOW (orange),11-segment main display (red), 11-segment sub-display (orange), laser ON (green), zero reset (green), ENABLE (green), MENU (green), HIGH threshold (orange), LOW threshold (orange)	
Power supply voltage	10 to 30 VDC, including 10% ripple(p-p)	
Power consumption	3,000 mW max. with power supply voltage of 30 VDC and power supply current of 100 mA max. (with Sensor connected)	
Ambient temperature	Operating: 0 to +50°C, Storage: –15 to +70°C (with no icing or condensation)	
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)	
Dielectric strength	1,000 VAC, 50/60 Hz for 1 minute	
Vibration resistance (destruction)	10 to 150 Hz, 0.7-mm double amplitude, 80 minutes each in X, Y, and Z directions	
Shock resistance (destruction)	300 m/s² 3 times each in six directions (up/down, left/right, forward/backward)	
Degree of protection	IEC60529, IP40	
Connection method	Prewired (standard cable length: 2 m)	
Weight (packed state)	Approx. 200 g (main unit only: approx. 135 g)	
Materials	Case: PBT (polybutylene terephthalate), Cover: Polycarbonate, Display: Acrylic resin, Buttons: Polyacetal, Cable: PVC	
Accessories	Instruction sheet	

(*1) In the case of a white ceramic OMRON standard object

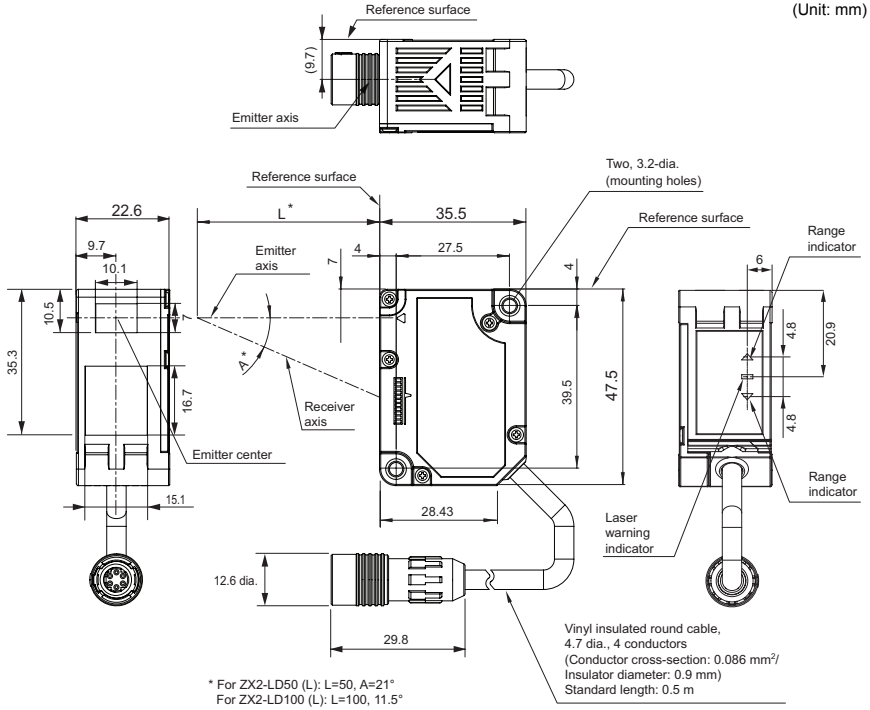
(*2) In the MENU mode, select and set current output (4 to 20 mA) and voltage output (±5 V or 1 to 5 V).

(*3) A Calculating Unit (ZX2-CAL) is required.
Mutual interference prevention is possible for up to five Amplifier Units, and calculations are possible for up to two.

Sensor Heads

ZX2-LD50/LD50L, ZX2-LD100/LD100L

(Unit: mm)

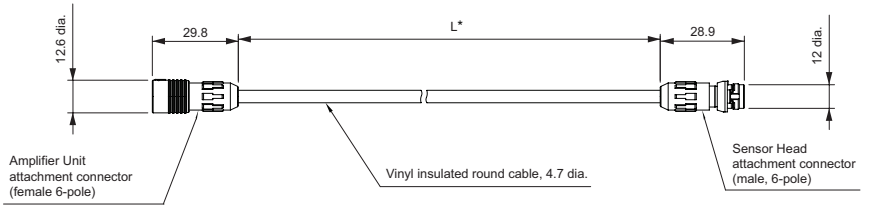


* For ZX2-LD50 (L): L=50, A=21°
For ZX2-LD100 (L): L=100, 11.5°

Sensor Head Extension Cables

ZX2-XC1R, ZX2-XC4R, ZX2-XC9R

(Unit: mm)



*L Cable lengths: ZX2-XC1R: 1 m, ZX2-XC4R: 4 m, ZX2-XC9R: 9 m

Note. Two or more extension cables cannot be connected in series.

Item \ Model	ZX2-XC1R	ZX2-XC4R	ZX2-XC9R
Cable type	Flex-resistance type		
Degree of protection	IP67		
Dielectric strength (connector)	No flashover and no breakdown at AC 300 V for 1 minute		
Insulation resistance (connector)	1000 MΩ min. (at 100 VDC)		
Weight (packed state)	Approx. 50 g	Approx. 150 g	Approx. 300 g
Materials	Connector: PPS and PBT, Cable: PVC		
Minimum bend radius	30 mm		
Accessories	Ferrite core x 2 (made by TDK Corp. ZCAT1730-0730A)		

Item \ Model	ZX2-LD50L	ZX2-LD50	ZX2-LD100L	ZX2-LD100
Optical system	Diffuse reflective			
Light source (wave length)	Visible-light semiconductor laser with a wavelength of 660 nm and an output of 1mW max.			
	EN class 2, FDA class II (*5)			
Measurement center distance	50 mm		100 mm	
Measurement range	±10 mm		±35 mm	
Beam shape	Line	Spot	Line	Spot
Beam size (*1)	Approx. 60 μm x 2.6 mm	Approx. 60 μm dia.	Approx. 110 μm x 2.7 mm	Approx. 110 μm dia.
Resolution (*2)	1.5 μm		5 μm	
Linearity (*3)	±0.05% F.S. (40 to 50 mm)	±0.1% F.S. (40 to 50 mm)	±0.05% F.S. (65 to 100 mm)	±0.1% F.S. (65 to 100 mm)
	±0.1% F.S. (entire range)	±0.15% F.S. (entire range)	±0.1% F.S. (entire range)	±0.15% F.S. (entire range)
Temperature characteristic (*4)	0.02% F.S./°C			
Ambient illumination	Incandescent lamp: 10,000 lx max. (on light receiving side)			
Ambient temperature	Operating: 0 to +50°C, Storage: –15 to +70°C (with no icing or condensation)			
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)			
Dielectric strength	1,000 VAC, 50/60 Hz for 1 minute			
Vibration resistance (destruction)	10 to 150 Hz, 0.7-mm double amplitude, 80 minutes each in X, Y, and Z directions			
Shock resistance (destruction)	300 m/s^2 3 times each in six directions (up/down, left/right, forward/backward)			
Degree of protection	IEC60529, IP67			
Connection method	Connector connection (standard cable length: 500 mm)			
Weight (packed state)	Approx. 160 g (main unit only: approx. 75 g)			
Materials	Case and cover: PBT (polybutylene terephthalate), Optical window: Glass, Cable: PVC			
Accessories	Instruction sheet, ferrite core x 1 (made by TDK Corp. ZCAT1730-0730A), laser warning label (English), FDA certification label			

(Note) Highly reflective objects can result in incorrect detection by causing out-of-range measurements.

(*1) Beam size: The beam size is defined by 1/e^2 (13.5%) of the strength of the beam at the beam center (measured value).
Incorrect detection may occur if there is light leakage outside the defined spot and the material around the sensing object is more reflective than the sensing object.

(*2) Resolution: The resolution is the deviation (±3σ) in the analog output when connected to the ZX2-LDA Amplifier Unit. (The resolution is measured with the standard reference object (white ceramic), at the measurement point when the response time of the ZX2-LDA is set to 128 ms.)
The resolution is given at the repeat accuracy for a stationary workpiece, and is not an indication of the distance accuracy.
The resolution may be adversely affected under strong electromagnetic fields.

(*3) Linearity: The linearity is given as the error in an ideal straight line displacement output when measuring the standard reference object.
The linearity and measurement values vary with the object being measured. F.S. is the entire measurement range. (ZX2-LD50□:20mm)

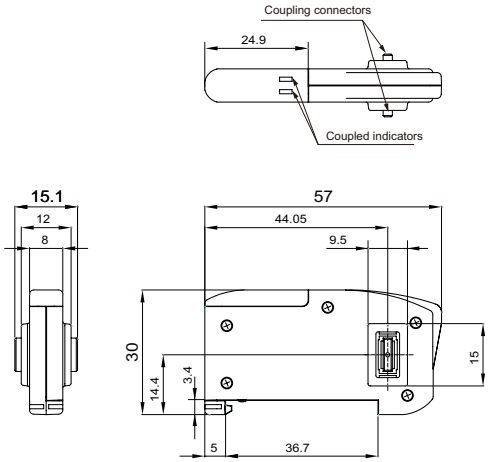
(*4) Temperature characteristic: The temperature characteristic is measured at the measurement center distance with the Sensor and reference object (OMRON's standard reference object) secured with an aluminum jig.

(*5) Categorized as Class 2 by EN60825-1 criteria in accordance with the stipulations of the FDA standard Laser Notice No.50, and registered with CDRH (Center for Devices and Radiological Health) (accession number: 1020665-000)

Calculating Unit

ZX2-CAL

(Unit: mm)

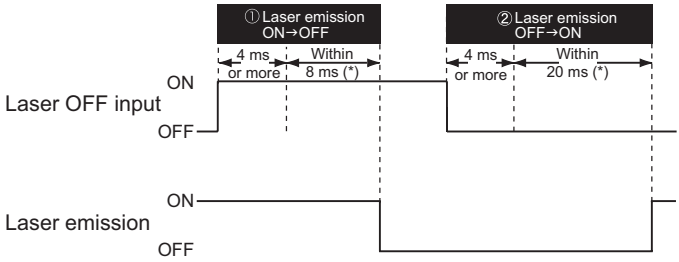


Item \ Model	ZX2-CAL
Applicable Amplifier Units	ZX2-LDA11/ZX2-LDA41
Current consumption	12 mA max. (supplied from the Smart Sensor Amplifier Unit)
Ambient temperature	Operating: 0 to +50°C, Storage: –15 to +70°C (with no icing or condensation)
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)
Connection method	Connector
Dielectric strength	1,000 VAC, 50/60 Hz for 1 minute
Vibration resistance (destruction)	10 to 150 Hz, 0.7 mm double amplitude, 80 minutes each in X, Y, and Z directions
Shock resistance (destruction)	300 m/s^2 3 times each in six directions (up/down, left/right, forward/backward)
Materials	Case: ABS, Display: Acrylic resin
Weight (packed state)	Approx. 50 g (main unit only: approx. 15 g.)
Accessories	Instruction sheet

Timing Charts

This section explains the timing charts for the I/O signals that are exchanged between the Controller and external devices.

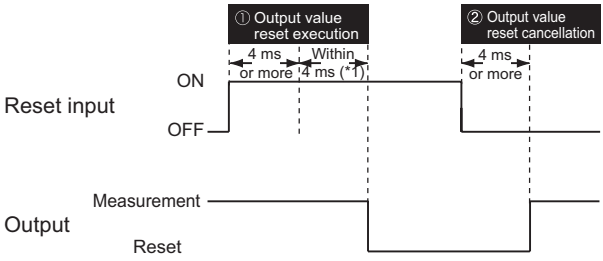
Laser OFF input



①	**Laser emission ON → OFF**	If laser OFF input is ON for 4 ms or more, the signal is received, and laser emission is turned OFF within 8 ms.
②	**Laser emission OFF → ON**	If laser OFF input is OFF for 4 ms or more, the signal is received, and laser emission is turned ON within 20 ms.

(*) The value is within 150 ms when mutual interference prevention is set to ON.

Reset input



①	**Output value reset execution**	If reset input is ON for 4 ms or more, the signal is received, and output is reset within 4 ms.
②	**Output value reset cancellation**	If reset input is OFF for 4 ms or more, measurement is resumed. Acquire the measurement results after the preset response time elapses. (*2)

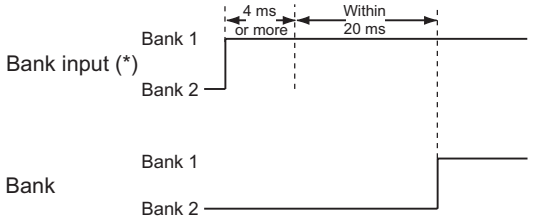
(*1) The value is within 150 ms when mutual interference prevention is set to ON.

(*2) When connecting two or more Amplifier Units, acquire the measurement results after the response time specified for connecting two or more units elapses. **(See page 82.)**

Bank input

• When only one Amplifier Unit is used

Example: Switching from bank 2 to bank 1

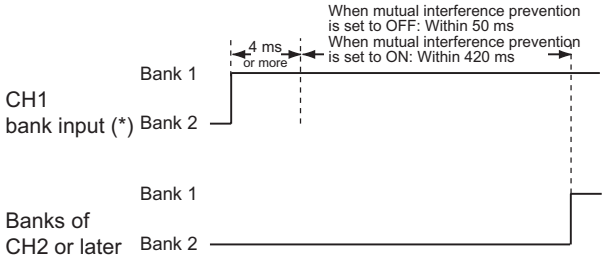


(*) Bank input is executed by the ON/OFF combinations of BANK input 0 and BANK input 1.

If a bank input signal is input for 4 ms or more, the bank is determined, the bank is switched within 20 ms, and then measurement is resumed.
Acquire the measurement results after the preset response time elapses.

• When connecting two or more Amplifier Units

Example: Switching from bank 2 to bank 1

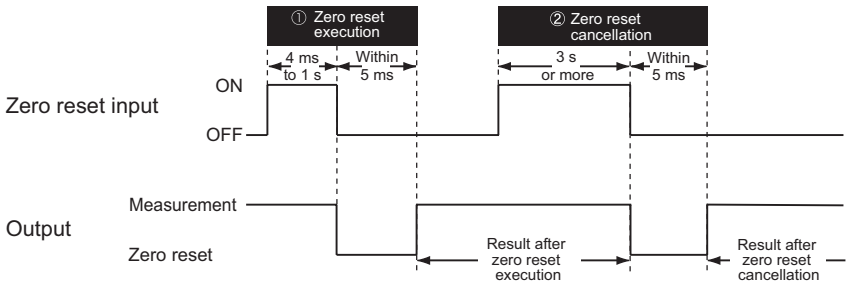

When mutual interference prevention is set to OFF: Within 50 ms
When mutual interference prevention is set to ON: Within 420 ms
4 ms or more
Bank 1
CH1 bank input (*)
Bank 2
Bank 1
Banks of CH2 or later
Bank 2

(*) Bank input is executed by the ON/OFF combinations of CH1 BANK input 0 and CH1 BANK input 1 when connecting two or more Amplifier Units.

If a CH1 bank input signal is input for 4 ms or more, the bank is determined, the bank is switched within 50 ms if mutual interference prevention is set to OFF, and within 420 ms if mutual interference prevention is set to ON, and then measurement is resumed.
Acquire the measurement results after the response time specified for connecting two or more Amplifier Units elapses. **(See page 82.)**

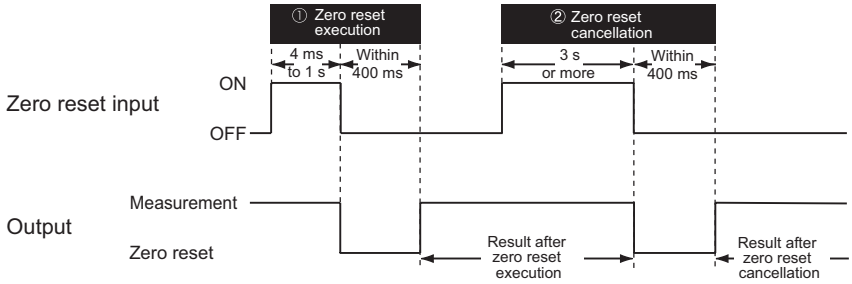
Zero reset input

• When the zero reset memory setting is OFF



①	**Zero reset execution**	Turn OFF after 4 ms to 1 s zero reset input turns ON. The zero reset is executed, and measurement is resumed within 5 ms. Acquire the measurement results after the preset response time elapses. (*)
②	**Zero reset cancellation**	Turn OFF after zero reset input turns ON for 3 s or more. The zero reset is canceled, and measurement is resumed within 5 ms. Acquire the measurement results after the preset response time elapses. (*)

• When the zero reset memory setting is ON



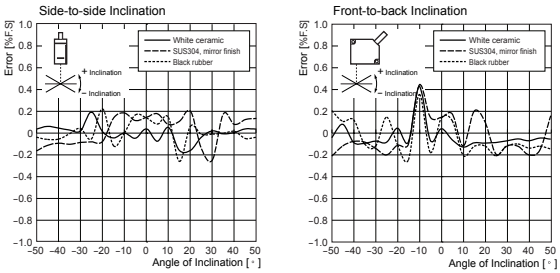
①	**Zero reset execution**	Turn OFF after 4 ms to 1 s zero reset input turns ON. The zero reset is executed, and measurement is resumed within 400 ms. Acquire the measurement results after the preset response time elapses. (*)
②	**Zero reset cancellation**	Turn OFF after zero reset input turns ON for 3 s or more. The zero reset is canceled, and measurement is resumed within 400 ms. Acquire the measurement results after the preset response time elapses. (*)

(*) When connecting two or more Amplifier Units, acquire the measurement results after the response time specified for connecting two or more units elapses.**(See page 82.)**

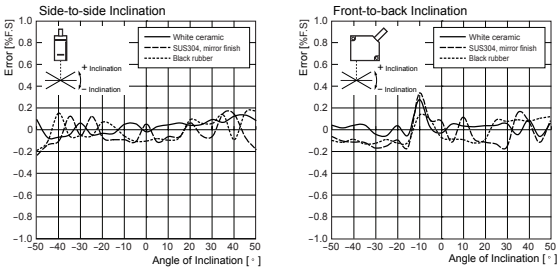
Angle Characteristic

The angle characteristic is a plot of the inclination of the sensing object in the measurement range and the maximum value of the error to analog output.
Note: SUS304 = Stainless steel SUS304

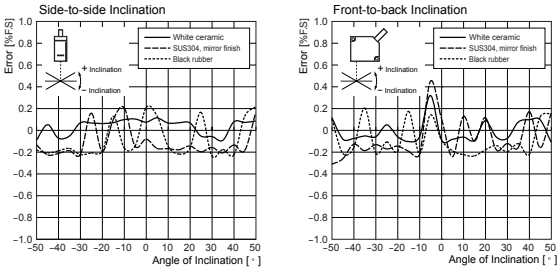
ZX2-LD50



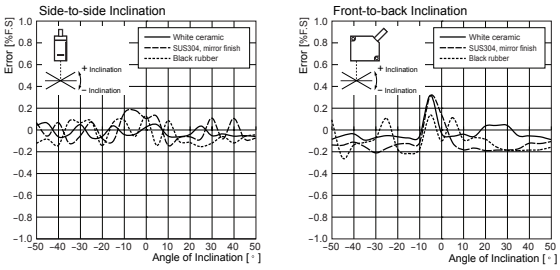
ZX2-LD50L



ZX2-LD100

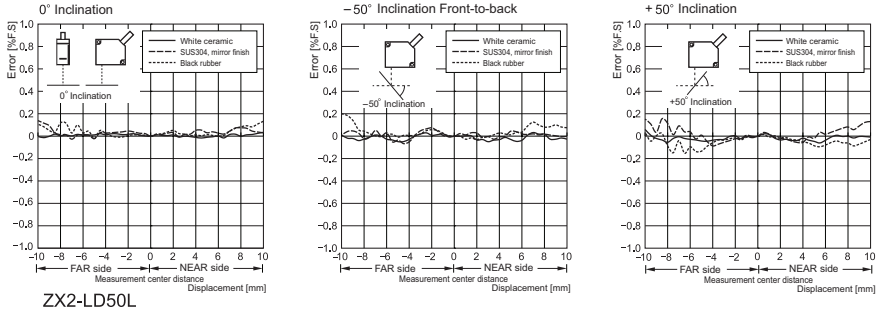


ZX2-LD100L

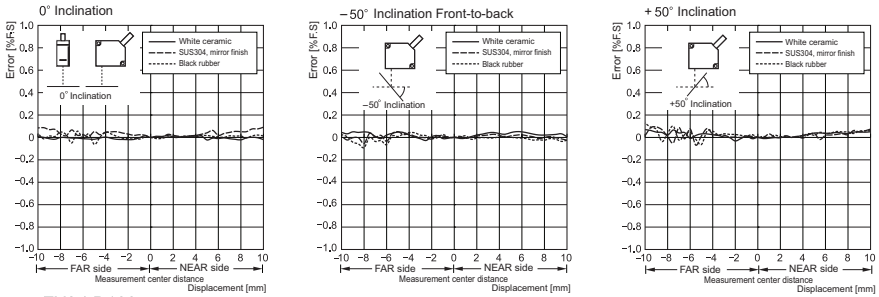


Linearity Characteristic for Different Materials

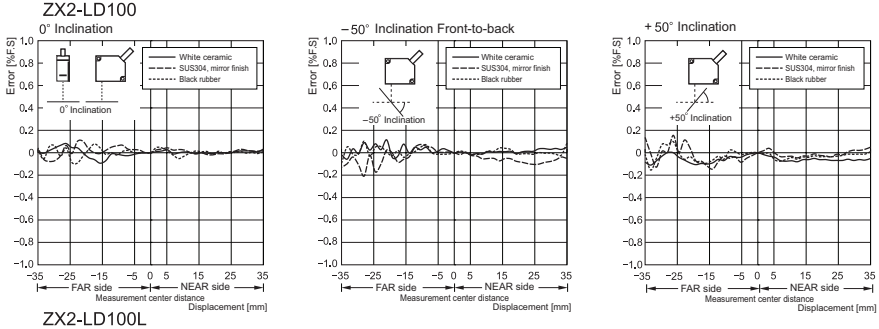
ZX2-LD50



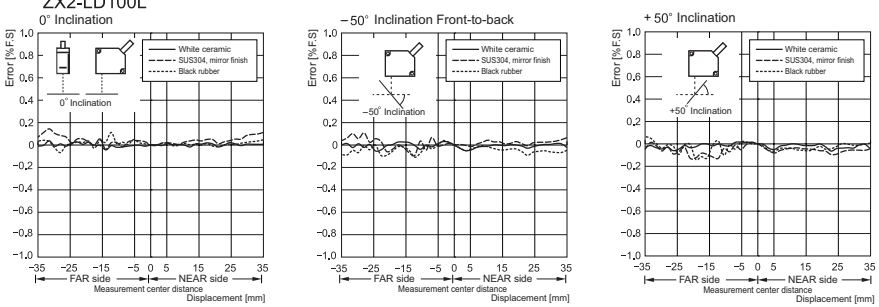
ZX2-LD50L



ZX2-LD100



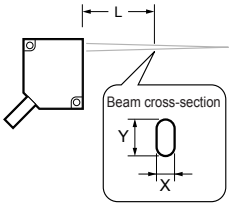
ZX2-LD100L



Note. X axis displacement: Measurement distance displayed on the Amplifier Unit
For the measurement distance displayed on the Amplifier Unit, the measurement center distance is displayed as 0, and the NEAR and FAR sides from the sensor are displayed by + and -, respectively.

Beam Size

■ Spot Beams



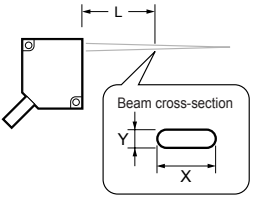
ZX2-LD50

L	+10 mm	0 mm	-4 mm	-10 mm
X	Approx. 600 µm	Approx. 160 µm	Approx. 40 µm	Approx. 220 µm
Y	Approx. 350 µm	Approx. 90 µm	Approx. 60 µm	Approx. 130 µm

ZX2-LD100

L	+35 mm	0 mm	-20 mm	-35 mm
X	Approx. 1.1 mm	Approx. 400 µm	Approx. 70 µm	Approx. 250 µm
Y	Approx. 550 µm	Approx. 190 µm	Approx. 110 µm	Approx. 150 µm

■ Line Beams



ZX2-LD50L

L	+10 mm	0 mm	-4 mm	-10 mm
X	Approx. 2.6 mm	Approx. 2.6 mm	Approx. 2.6 mm	Approx. 2.6 mm
Y	Approx. 350 µm	Approx. 90 µm	Approx. 60 µm	Approx. 130 µm

ZX2-LD100L

L	+35 mm	0 mm	-20 mm	-35 mm
X	Approx. 2.1 mm	Approx. 2.5 mm	Approx. 2.7 mm	Approx. 2.9 mm
Y	Approx. 550 µm	Approx. 190 µm	Approx. 110 µm	Approx. 150 µm

Note. L: Measurement distance displayed on the Amplifier Unit (For the measurement distance displayed on the Amplifier Unit, the measurement center distance is displayed as 0, and the NEAR and FAR sides from the sensor are displayed by + and -, respectively.)

INDEX

Numerics

1 . 5V (analog output 1 to 5 V) 105
2-sensor operation (thickness) 58
2-sensor operation (A-B) 48
4 .20MA (analog output 4 to 20 mA) 105
-5 . 5V (analog output ±5 V) 105

A

A-b (2-sensor operation A-B) 48
Active Smart Tuning 81
Amplifier Unit
  Connecting the Sensor Head to the Amplifier Unit 27
  Connecting Two or More Amplifier Units 82
  Installing 24
  Part Names and Functions 19
  Specifications and Dimensions 132
Analog Output 105
Angle Characteristic 140
A-OUt (analog output) 105
AVE (hold measured value average) 42, 52, 60, 74, 90

B

bANK (bank switching) 96, 115
Bank Setting 95
Bank Switching 96, 115
Basic Configuration 18
BASIC SETUP 38
Beam Size 135, 142
AVE (hold minimum value) 42, 52, 60, 74, 90

C

CALC (2-sensor operation) 48, 58
Calculating Unit
  Connecting 25
  Part Names and Functions 22
  Specifications and Dimensions 136
Canceling the Key Lock 118
CLAMP (output for non-measurement clamp/clamp value) 108
Clamp value 108
Connecting
  Calculating Unit 25
  Sensor Head and Amplifier Unit 27
Connecting the Sensor Head to the Amplifier Unit 27

D

Default Settings 119
Default Value 119
dEtAI L (detail menu display) 40, 46, 50, 56, 64, 70, 84, 87, 89, 95, 98, 101, 107, 110, 112, 114, 116
dEtECt 116
dI FF 112
Display of RUN Mode 38
Double Sheet Detection 50

E

E-bACt 125, 126
E-CH 126
E-dARK 126
E-HEAd 126, 127
E-MEM 127
Engineering Data (Typical)
  Angle Characteristic 140
  Beam Size 142
  Linearity Characteristic for Different Materials 141
Error Messages 126
E-SHRt 127
E-SYS 127
External Input 114
Ext-I N (external input) 114

F

FIRST (detection surface selection FIRST) 116
FLOW OF OPERATION 34

H

Hold 42, 52, 60, 73, 89
HOLd (hold) 42, 52, 60, 73, 90
HYS (hysteresis width) 88
Hysteresis 87

I

I/O Circuit Diagrams
PNP Amplifier Unit 32
INIt (initialization) 120
Initialization 119
Installing
Amplifier Unit 24
Sensor Head 23

K

KEEP (output for non-measurement keep) 108
Key Lock Function 118
K-LOCK (key lock enabled) 118

L

LddOWN 128
LD-OFF input 29
Linearity Characteristic for Different Materials 141

M

Main Display 19, 20
MAX (clamp value MAX) 108
MAX (detection surface selection MAX) 116
Measuring Eccentricity and Surface Deflection 70
Measuring Height 40
Measuring Thickness 55
Multi Smart Tuning 80
Mutual Interference Prevention 46, 56, 84

N

I/O Circuit Diagrams
NPN Amplifier Unit 31

O

OFF-delay timer 110
OFFtIM (OFF-delay timer) 110
ON-delay timer 110
ONtIM (ON-delay timer) 110
Output for Non-measurement 107

P

Part Names and Functions 18
Amplifier Unit 19
Calculating Unit 22
Sensor Head 22
PEAK (hold peak) 42, 52, 60, 74, 90
Positioning 64
PREPARATION FOR MEASUREMENT 17
P tO P (hold peak-to-peak) 42, 52, 60, 74, 90

Q

Q&A 129

R

Reset Input 115
Reset input 30
Response time 46, 51, 56, 65, 71, 78
RSTOUT (output for non-measurement) 108

S

S1-AFt (scaling S1-Aft) 67, 72, 102, 103
S1-bEF (scaling S1-Bef) 67, 72, 102, 103
S2-AFt (scaling S2-Aft) 68, 73, 103
S2-bEF (scaling S2-Bef) 68, 73, 103
SAMPLE (hold sample) 42, 52, 60, 74, 90
SCALE (scaling) 66, 72, 101
Scaling 66, 72, 101
SELF-d (self-trigger self-d) 43, 53, 61, 75, 92

SELFLV (self-trigger level) 43, 53, 61, 75, 93
SELF-U (self-trigger self-u) 43, 53, 61, 75, 92
Sensor Head
Part Names and Functions 22
Specifications and Dimensions 134
Sensor Head extension cable 134
Sensor Heads: Installing 23
Setting Transition Charts 148
Simplest Setting 38
Single Smart Tuning 38, 41, 47, 51, 57, 66, 71, 79
Smart Tuning 38, 41, 47, 51, 57, 66, 71, 78
SMART/ACTIVE 81
SMART/MULTI 80
SMART/SINGLE 38, 41, 47, 51, 57, 66, 71, 79
Specifications and Dimensions
Amplifier Unit 132
Calculating Unit 136
Sensor Head 134
SPEED (response time) 41, 46, 51, 56, 65, 71, 78
Steps and Warpage 45
Sub-display 19, 20
SYNC (mutual interference prevention) 46, 56, 85

T

THICK (2-sensor operation thickness) 58
Threshold Setting 44, 48, 54, 62, 69, 76
Timer 110
TIMING (self-trigger timing input) 43, 53, 61, 75, 92
Timing Charts 137
Timing input 93, 115
TIMRST (timing input/reset input) 115
TRIG (self-trigger) 42, 52, 61, 74, 92
Troubleshooting 124
TUNING/MULTI 80
TUNING/SINGLE 38, 41, 47, 51, 57, 66, 71, 79

W

Wiring Diagram 28
Wiring Input/Output Cables 28

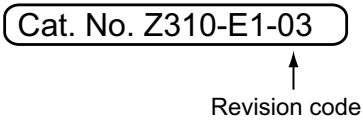
Z

Zero Reset 97
Zero reset cancellation 100
ZRDI SP (display setting at zero reset) 99
ZRMEM (zero reset memory) 98

MEMO

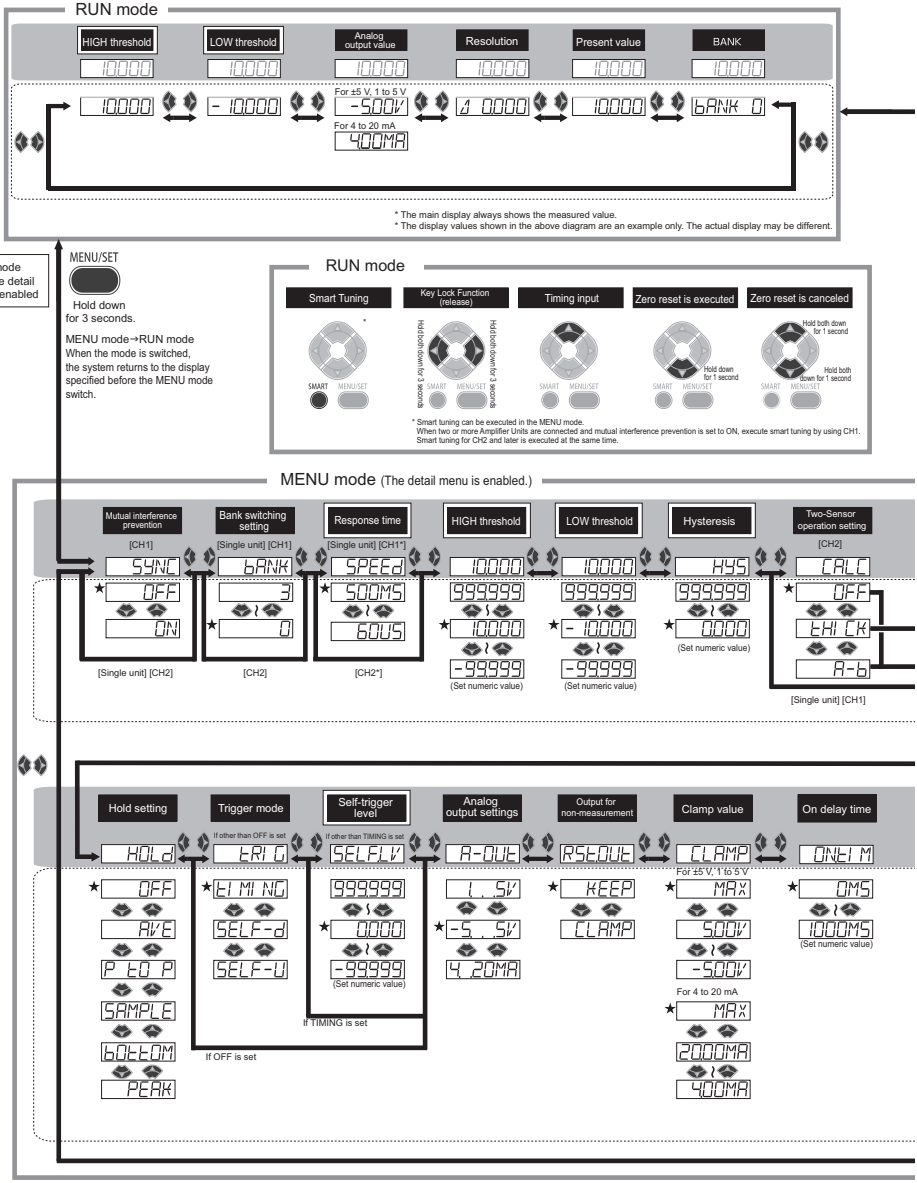
Revision History

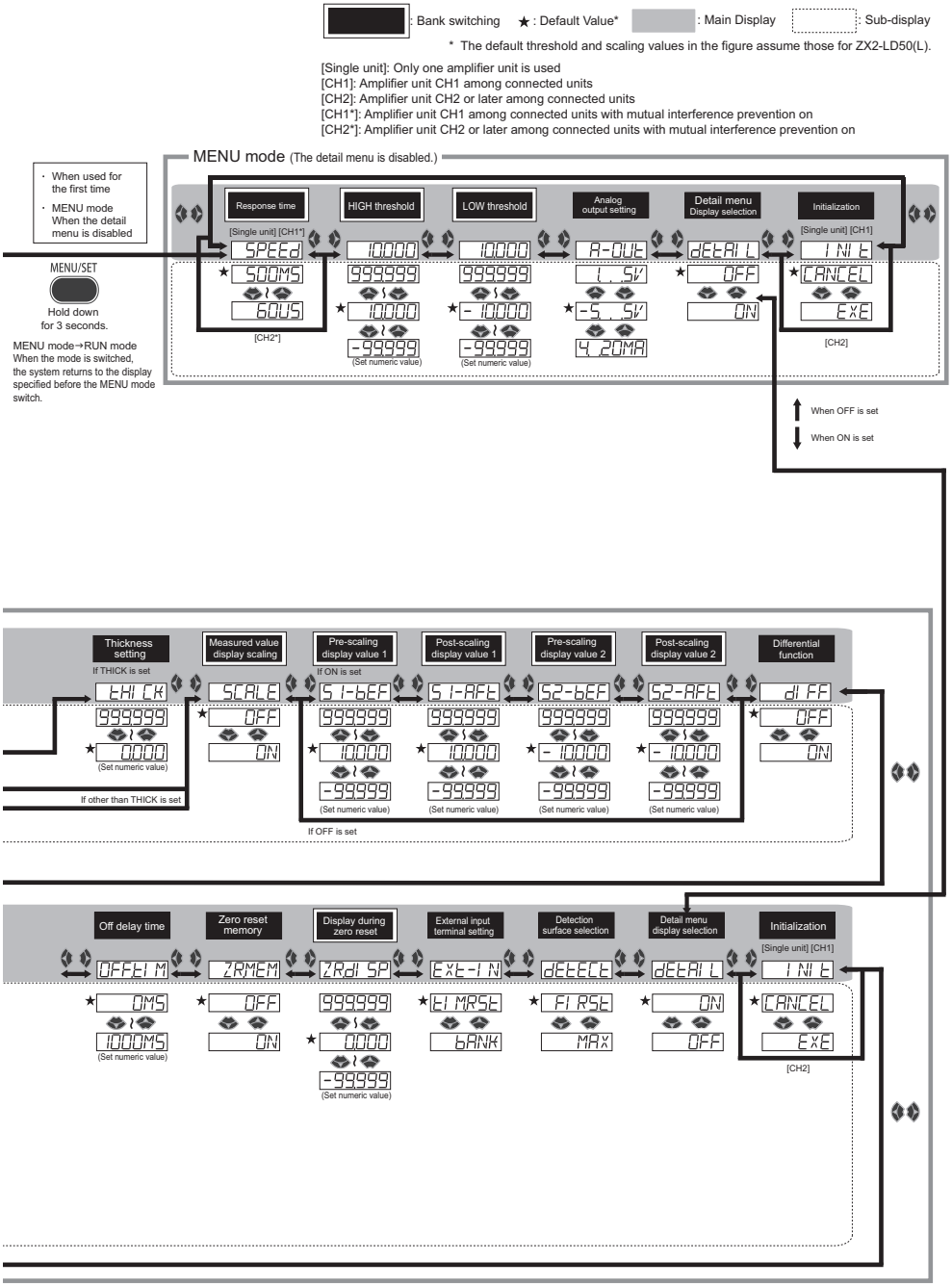
A manual revision code appears as a suffix to the catalog number at the bottom of the front and back covers of this manual.



Revision code	Date	Revised contents
01	Oct. 2010	Original production
02	Jan. 2011	General revision
03	Apr. 2011	General revision

SETTING TRANSITION CHARTS


RUN mode
HIGH threshold
LOW threshold
Analog output value
Resolution
Present value
BANK
For ±5 V, 1 to 5 V
For 4 to 20 mA
* The main display always shows the measured value.
* The display values shown in the above diagram are an example only. The actual display may be different.
· MENU mode When the detail menu is enabled
MENU/SET
Hold down for 3 seconds.
MENU mode→RUN mode When the mode is switched, the system returns to the display specified before the MENU mode switch.
RUN mode
Smart Tuning
Key Lock Function (release)
Timing input
Zero reset is executed
Zero reset is canceled
Hold down for 3 seconds
Hold down for 1 second
Hold both down for 1 second
* Smart tuning can be executed in the MENU mode.
When two or more Amplifier Units are connected and mutual interference prevention is set to ON, execute smart tuning by using CH1.
Smart tuning for CH2 and later is executed at the same time.
MENU mode (The detail menu is enabled.)
Mutual interference prevention
[CH1]
Bank switching setting
[Single unit] [CH1]
Response time
[Single unit] [CH1*]
HIGH threshold
LOW threshold
Hysteresis
Two-Sensor operation setting
[CH2]
(Set numeric value)
[Single unit] [CH2]
[CH2]
[CH2*]
[Single unit] [CH1]
Hold setting
Trigger mode
Self-trigger level
Analog output settings
Output for non-measurement
Clamp value
On delay time
If other than OFF is set
If other than TIMING is set
For ±5 V, 1 to 5 V
For 4 to 20 mA
If TIMING is set
If OFF is set


: Bank switching
★: Default Value*
: Main Display
: Sub-display
* The default threshold and scaling values in the figure assume those for ZX2-LD50(L).
[Single unit]: Only one amplifier unit is used
[CH1]: Amplifier unit CH1 among connected units
[CH2]: Amplifier unit CH2 or later among connected units
[CH1*]: Amplifier unit CH1 among connected units with mutual interference prevention on
[CH2*]: Amplifier unit CH2 or later among connected units with mutual interference prevention on
MENU mode (The detail menu is disabled.)
· When used for the first time
· MENU mode When the detail menu is disabled
MENU/SET
Hold down for 3 seconds.
MENU mode→RUN mode
When the mode is switched, the system returns to the display specified before the MENU mode switch.
Response time
[Single unit] [CH1*]
SPEED
500MS
60US
[CH2*]
HIGH threshold
999999
10000
(Set numeric value)
LOW threshold
-10000
-99999
Analog output setting
A-OUT
1-5V
4-20MA
Detail menu Display selection
DETAIL
OFF
ON
Initialization
[Single unit] [CH1]
INIT
CANCEL
EXE
[CH2]
When OFF is set
When ON is set
Thickness setting
If THICK is set
THICK
0000
If other than THICK is set
Measured value display scaling
SCALE
Pre-scaling display value 1
If ON is set
S1-SEt
Post-scaling display value 1
S1-ASt
Pre-scaling display value 2
S2-SEt
Post-scaling display value 2
S2-ASt
If OFF is set
Differential function
diFF
Off delay time
OFFTIM
0MS
1000MS
Zero reset memory
ZRMEM
Display during zero reset
ZRDISP
External input terminal setting
EXT-IN
TIMRST
BANK
Detection surface selection
DETECT
FIRST
MAX
Detail menu display selection
DETAIL

Terms and Conditions of Sale

1. Offer; Acceptance. These terms and conditions (these "Terms") are deemed part of all quotes, agreements, purchase orders, acknowledgments, price lists, catalogs, manuals, brochures and other documents, whether electronic or in writing, relating to the sale of products or services (collectively, the "Products") by Omron Electronics LLC and its subsidiary companies ("Omron"). Omron objects to any terms or conditions proposed in Buyer's purchase order or other documents which are inconsistent with, or in addition to, these Terms.
2. Prices; Payment Terms. All prices stated are current, subject to change without notice by Omron. Omron reserves the right to increase or decrease prices on any unshipped portions of outstanding orders. Payments for Products are due net 30 days unless otherwise stated in the invoice.
3. Discounts. Cash discounts, if any, will apply only on the net amount of invoices sent to Buyer after deducting transportation charges, taxes and duties, and will be allowed only if (i) the invoice is paid according to Omron's payment terms and (ii) Buyer has no past due amounts.
4. Interest. Omron, at its option, may charge Buyer 1-1/2% interest per month or the maximum legal rate, whichever is less, on any balance not paid within the stated terms.
5. Orders. Omron will accept no order less than $200 net billing.
6. Governmental Approvals. Buyer shall be responsible for, and shall bear all costs involved in, obtaining any government approvals required for the importation or sale of the Products.
7. Taxes. All taxes, duties and other governmental charges (other than general real property and income taxes), including any interest or penalties thereon, imposed directly or indirectly on Omron or required to be collected directly or indirectly by Omron for the manufacture, production, sale, delivery, importation, consumption or use of the Products sold hereunder (including customs duties and sales, excise, use, turnover and license taxes) shall be charged to and remitted by Buyer to Omron.
8. Financial. If the financial position of Buyer at any time becomes unsatisfactory to Omron, Omron reserves the right to stop shipments or require satisfactory security or payment in advance. If Buyer fails to make payment or otherwise comply with these Terms or any related agreement, Omron may (without liability and in addition to other remedies) cancel any unshipped portion of Products sold hereunder and stop any Products in transit until Buyer pays all amounts, including amounts payable hereunder, whether or not then due, which are owing to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.
9. Cancellation; Etc. Orders are not subject to rescheduling or cancellation unless Buyer indemnifies Omron against all related costs or expenses.
10. Force Majeure. Omron shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.
11. Shipping; Delivery. Unless otherwise expressly agreed in writing by Omron:
    a. Shipments shall be by a carrier selected by Omron; Omron will not drop ship except in "break down" situations.
    b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
    c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
    d. Delivery and shipping dates are estimates only; and
    e. Omron will package Products as it deems proper for protection against normal handling and extra charges apply to special conditions.
12. Claims. Any claim by Buyer against Omron for shortage or damage to the Products occurring before delivery to the carrier must be presented in writing to Omron within 30 days of receipt of shipment and include the original transportation bill signed by the carrier noting that the carrier received the Products from Omron in the condition claimed.
13. Warranties. (a) Exclusive Warranty. Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied. (b) Limitations. OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right. (c) Buyer Remedy. Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty. See http://www.omron247.com or contact your Omron representative for published information.
14. Limitation on Liability; Etc. OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.
15. Indemnities. Buyer shall indemnify and hold harmless Omron Companies and their employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Omron and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party.
16. Property; Confidentiality. Any intellectual property in the Products is the exclusive property of Omron Companies and Buyer shall not attempt to duplicate it in any way without the written permission of Omron. Notwithstanding any charges to Buyer for engineering or tooling, all engineering and tooling shall remain the exclusive property of Omron. All information and materials supplied by Omron to Buyer relating to the Products are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and strictly prevent disclosure to any third party.
17. Export Controls. Buyer shall comply with all applicable laws, regulations and licenses regarding (i) export of products or information; (iii) sale of products to "forbidden" or other proscribed persons; and (ii) disclosure to non-citizens of regulated technology or information.
18. Miscellaneous. (a) Waiver. No failure or delay by Omron in exercising any right and no course of dealing between Buyer and Omron shall operate as a waiver of rights by Omron. (b) Assignment. Buyer may not assign its rights hereunder without Omron's written consent. (c) Law. These Terms are governed by the law of the jurisdiction of the home office of the Omron company from which Buyer is purchasing the Products (without regard to conflict of law principles). (d) Amendment. These Terms constitute the entire agreement between Buyer and Omron relating to the Products, and no provision may be changed or waived unless in writing signed by the parties. (e) Severability. If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) Setoff. Buyer shall have no right to set off any amounts against the amount owing in respect of this invoice. (g) Definitions. As used herein, "including" means "including without limitation"; and "Omron Companies" (or similar words) mean Omron Corporation and any direct or indirect subsidiary or affiliate thereof.

Certain Precautions on Specifications and Use

1. Suitability of Use. Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases but the following is a non-exhaustive list of applications for which particular attention must be given:
   (i) Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
   (ii) Use in consumer products or any use in significant quantities.
   (iii) Energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
   (iv) Systems, machines and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to this Product.
   NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON'S PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
2. Programmable Products. Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.
3. Performance Data. Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.
4. Change in Specifications. Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.
5. Errors and Omissions. Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

OMRON
INDUSTRIAL AUTOMATION

OMRON INDUSTRIAL AUTOMATION • THE AMERICAS HEADQUARTERS
Schaumburg, IL USA • 847.843.7900 • 800.556.6766 • www.omron247.com

OMRON CANADA, INC. • HEAD OFFICE
Toronto, ON, Canada • 416.286.6465 • 866.986.6766 • www.omron247.com

OMRON ELECTRONICS DE MEXICO • HEAD OFFICE
México DF • 52.55.59.01.43.00 • 001.800.556.6766 • mela@omron.com

OMRON ELECTRONICS DE MEXICO • SALES OFFICE
Apodaca, N.L. • 52.81.11.56.99.20 • 001.800.556.6766 • mela@omron.com

OMRON ELETRÔNICA DO BRASIL LTDA • HEAD OFFICE
São Paulo, SP, Brasil • 55.11.2101.6300 • www.omron.com.br

OMRON ARGENTINA • SALES OFFICE
Cono Sur • 54.11.4783.5300

OMRON CHILE • SALES OFFICE
Santiago • 56.9.9917.3920

OTHER OMRON LATIN AMERICA SALES
54.11.4783.5300

OMRON EUROPE B.V. • Wegalaan 67-69, NL-2132 JD, Hoofddorp, The Netherlands. • Tel: +31 (0) 23 568 13 00
Fax: +31 (0) 23 568 13 88 • www.industrial.omron.eu

Z310-E1-03 03/11 Note: Specifications are subject to change. © 2011 Omron Electronics LLC Printed in U.S.A.